ES 1203 A

Arachnologische Mitteilungen

NATURAL HISTORY
MUSEUM LIBRARY
10 MAR 2014
PURCHASED

Heft 46
ISSN 1018 - 4171

Karlsruhe, November 2013
www.AraGes.de/aramit

Herausgeber:
Arachnologische Gesellschaft e.V.
URL: http://www.AraGes.de

Arachnologische Mitteilungen

Schriftleitung:
Theo Blick, Senckenberg Gesellschaft für Naturforschung,
Terrestrische Zoologie, Projekt Hessische Naturwaldreservate, Senckenberganlage 25,
D-60325 Frankfurt/M., E-Mail: theo.blick@senckenberg.de, aramit@theoblick.de
Dr. Sascha Buchholz, Technische Universität Berlin,
Institut für Ökologie, Rothenburgstr. 12, D-12165 Berlin,
E-Mail: sascha.buchholz@tu-berlin.de

Redaktion:
Theo Blick, Frankfurt
Dr. Jason Dunlop, Berlin
Dr. Sascha Buchholz, Berlin
Dr. Ambros Hänggi, Basel
Dr. Hubert Höfer & Stefan Scharf, Karlsruhe (Satz und Repro, E-Mail: hubert.hoefer@smnk.de)

Wissenschaftlicher Beirat:
Dr. Elisabeth Bauchhenß, Wien (AT); Dr. Peter Bliss, Halle/S. (DE); Prof. Dr. Jan Buchar, Praha (CZ); Dr. Maria Chatzaki, Alexandroupoli (GR); Petr Dolejš, Praha (CZ); Prof. Dr. Martin Entling, Landau/Pf. (DE); Dr. Oliver-David Finch, Rastede (DE); Dr. Izabela Hajdamowicz, Siedlce (PL); Prof. Dr. Peter J. van Helsdingen, Leiden (NL); Dr. Marco Isaia, Torino (IT); Dr. Peter Jäger, Frankfurt/M. (DE); Dr. Alberto Jiménez-Valverde, Málaga (SP); Dr. Christian Komposch, Graz (AT); Dr. Boris Leroy, Paris (FR); Dr. Volker Mahnert, Douvaine (FR); Prof. Dr. Jochen Martens, Mainz (DE); Dr. Dieter Martin, Waren (DE); Dr. Tone Novak, Maribor (SI); Dr. Ferenc Samu, Budapest (HU); Dr. Uwe Riecken, Bonn (DE); Prof. Dr. Wojciech Starega, Warszawa (PL)

Erscheinungsweise:
Pro Jahr 2 Hefte. Die Hefte sind laufend durchnummeriert und jeweils abgeschlossen paginiert.
Der Umfang je Heft beträgt ca. 50 Seiten. Erscheinungsort ist Karlsruhe. Auflage 450 Exemplare
Druck: Druckerei Isensee, Oldenburg.

Autorenhinweise/Instructions for authors:
bei der Schriftleitung erhältlich, oder unter der URL: http://www.arages.de/aramit/

Bezug:
Im Mitgliedsbeitrag der Arachnologischen Gesellschaft enthalten (25 Euro, Studierende 15 Euro pro Jahr), ansonsten beträgt der Preis für das Jahresabonnement 25 Euro. Die Kündigung der Mitgliedschaft oder des Abonnements wird jeweils zum Jahresende gültig und muss der AraGes bis 15. November vorliegen.

Bestellungen sind zu richten an:
Dr. Peter Michalik, Zoologisches Institut und Museum, Johann-Sebastian-Bach-Straße 11/12,
D-17489 Greifswald, Tel. +49 (0)3834 86-4099, Fax +49 (0)3834 86-4252
E-Mail: michalik@uni-greifswald.de oder via Homepage: www.AraGes.de (Beitrittsformular).

Die Bezahlung soll jeweils im ersten Quartal des Jahres erfolgen auf das Konto:
Arachnologische Gesellschaft e.V.; Kontonummer: 8166 27-466; Postbank Dortmund, BLZ 440 100 46
IBAN DE75 4401 0046 0816 6274 66, BIC (SWIFT CODE) PBNKDEFF

Die Arachnologischen Mitteilungen sind berücksichtigt in:
Scopus (http://info.scopus.com), **E-Bibliothek** (http://rzblx1.uni-regensburg.de/ezeit), **Directory of Open Access Journals** (http://www.doaj.org), **Zoological Records, Biological Abstracts, Index Copernicus Journals Master List 2012** (http://jml2012.indexcopernicus.com/Arachnologische+Mitteilungen,p1166,3.html).

Umschlagzeichnung: P. Jäger, K. Rehbinder

Arachnologische Mitteilungen 46: 1–53, i–x

Karlsruhe, November 2013

Arachnologische Mitteilungen 46: 1-5 Karlsruhe, November 2013

NATURAL HISTORY MUSEUM LIBRARY
10 MAR 2014
PURCHASED

Aberrante Epigynenbildungen bei der Wolfspinne *Pardosa palustris* (Araneae, Lycosidae)

Dieter Martin

doi: 10.5431/aramit4601

Abstract. Aberrant epigyne shapes in the wolf spider *Pardosa palustris* (Araneae, Lycosidae). Two cases of aberrant epigyne shape in *Pardosa palustris* (Linnaeus, 1758) are described. Characteristic is the absence of the posterior lateral parts of the septum. Possible causes, such as 'genital damage' during mating or the effects of parasite infestation, are discussed.

Key words: aberration of copulatory organs, genital damage, parasite infestation, teratology

Die in Bau und Funktion artspezifischen und arttrennenden Kopulationsorgane der Spinnen sind morphologisch relativ konstant (Huber 2004). Während asymmetrische, meistens gynandromorphe oder intersexuelle Missbildungen noch relativ oft gefunden werden (z.B. Holm 1941, Kaston 1961), bleiben symmetrische Aberrationen, die außerhalb der normalen arteigenen Variabilitätsspanne liegen, extrem selten (Jocqué 2002). Die betroffenen Exemplare können dann oft keiner bekannten Art zugeordnet werden und geben manchmal Anlass für die Beschreibung neuer Taxa (Beaumont 1991).

Spinnenweibchen mit stark aberranten Epigynen wurden bislang nur von Arten der *Pardosa monticola*-Gruppe (Lycosidae) bekannt (Bergthaler 1997, Samu nach Jocqué 2002). Die nach Tongiorgi (1966a) 18 westeuropäische Arten umfassende *monticola*-Gruppe ist genitalmorphologisch klar definiert und von den übrigen Artengruppen der Gattung *Pardosa* gut abgegrenzt. In sich ist sie jedoch recht einheitlich und besonders die Weibchen sind schwer zu unterscheiden (Tongiorgi 1966a). Die nach gruppenspezifischem Muster ausgeprägte Epigynenplatte (Septum) weist bei allen Arten eine mehr oder weniger hohe Form-Variabilität auf, die eine sichere Determination oft nur in Kombination mit anderen – allerdings vielfach ebenso variablen – Merkmalen, z. B. der Prosoma-Zeichnung, zulässt (z. B. Tongiorgi 1966a, 1966b, Fuhn & Niculesu-Burlacu 1971, Nentwig et. al. 2013).

Pardosa palustris (Linnaeus, 1758) ist die innerhalb der Gruppe am leichtesten zu erkennende Art. Sie ist durch die breit ausladenden, seitlich abgerundeten hinteren Septumflügel und eine mediane Depression im vorderen Septumdrittel sowie die durchgehende, gleichmäßig gerundete Abgrenzung der vorderen Epigynentasche gut erkennbar (Nentwig et al. 2013). Dennoch ist auch bei dieser Art eine große Variabilität in der Septumform besonders im Bereich der Flügel zu beobachten (Tambs-Lyche 1941, Nentwig et al. 2013).

Bergthaler (1997) beschreibt zwei *Pardosa*-Weibchen mit aberranten Epigynenbildern, die er keiner Art sicher zuordnen kann. Während der Bau der Vulva mit *Pardosa palustris* übereinstimmt, verweist die Prosoma-Zeichnung eher auf *Pardosa agrestis*. Er lässt die Frage offen, ob es sich um eine teratologische Fehlbildung, Hybridisation oder gar um eine unbekannte Art handelt.

In vorliegender Mitteilung sollen zwei weitere *Pardosa*-Weibchen mit aberranten Epigynen vorgestellt werden. Darüber hinaus werden mögliche Ursachen für das abweichende Erscheinungsbild der Epigynen diskutiert.

Material und Methoden

Insgesamt standen dem Verfasser 3319 *Pardosa palustris*-Weibchen zur Verfügung. Darunter befanden sich zwei genitalmorphologisch aberrante Exemplare. Diese werden in vorliegender Arbeit als A1 und A2 bezeichnet (Tab. 1). Zum Vergleich wurde ein Tier mit „normal" ausgebildeter Epigyne ausgewählt (N). Die von Bergthaler (1997) publizierten Epigynenbilder werden als Bergthaler A und Bergthaler B ausgewiesen. Eine Untersuchung der Originalbelege von Bergthaler war leider nicht möglich.

Die Spinnen wurden unter Flüssigkeit (70 % Alkohol) in Sand fixiert und unter einem Binokular (Müller Expert Trino mit DCM 310 Mikroskop-

Dr. sc. Dieter MARTIN, Lindenweg 11, 17213 Untergöhren,
e-mail: dieter_martin.untergoehren@t-online.de

eingereicht 3.2.2013, angenommen 16.5.2013, online 22.6.2013

Tab. 1: Funddaten der untersuchten Spinnen.
Tab. 1: Collecting data of the examined specimen.

untersuchte Spinnen	A1	A2	N
Epigynenausprägung	Aberration	Aberration	Normal (Vergleich)
Funddatum	30.5.2011	28.4.1980	3.6.1972
Fundort	Woldegk, Hildebrandshagen	Leipzig-Möckern, Neuer Müllberg	Frohburg, Kaplanberg
Biotop	Deponie von Borken- und Holzresten auf Ödland	Ruderalfläche auf ehemaliger Müllkippe	Magerrasen auf ehemaliger Müllkippe
Messtischblatt	2547	4640	4941
Geograf. Breite	53°25'03"N	51°21'45"N	51°03'27"N
Geograf. Länge	13°36'39"E	12°19'45"E	12°32'43"E
Höhe über NN	101 m	140 m	182 m
Fangmethode	Bodenfalle	Bodenfalle	Handfang

kamera) bei ca. 40facher Vergrößerung bearbeitet und fotografiert. Beim Vergleichsexemplar N wurde danach die Epigyne separiert, um die Epigynenflügel manuell zu entfernen (s. u.). Die Belege befinden sich in der Sammlung des Verfassers.

Ergebnisse

Prosoma-Zeichnung und Fleckung der Femora (Abb. 1 und Abb. 2) sowie die durchgehende Begrenzung der vorderen Epigynentaschen und die mediane Depression des Septums (Abb. 4 und Abb. 5) weisen beide aberranten Tiere als *Pardosa palustris* aus (Tongiorgi 1966a). Beide Spinnen befinden sich in einem normalen körperlichen Zustand. Das Exemplar A2 ist allerdings durch die lange Aufbewahrung im Alkohol ausgeblichen.

Abb. 3 zeigt ein in der normalen Variationsbreite liegendes Bild der Septumform bei *Pardosa palustris*. Bei den aberranten Epigynen (Abb. 4 und Abb. 5) fehlen die breit ausladenden Septumflügel. Statt dessen ist der vordere Septumteil durch einen schmalen, sich caudad ankerförmig verbreiternden Steg mit dem Epigynenhinterrand verbunden.

Bei A1 sind beidseitig kräftige Chitinplatten in der seitlichen Begrenzung der Epigynengrube ausgebildet. Ansonsten erscheinen die Epigynenstrukturen kompakt und glatt (Abb. 4).

Im Gegensatz dazu macht die Epigyne von A2 im hinteren Teil einen eher unregelmäßigen, zerrissenen Eindruck (Abb. 5). Besonders in etwas seitlicher Ansicht scheint der vordere Septumteil in einer Bruchkante zu enden (Abb. 6, Pfeil). Zur experimentellen

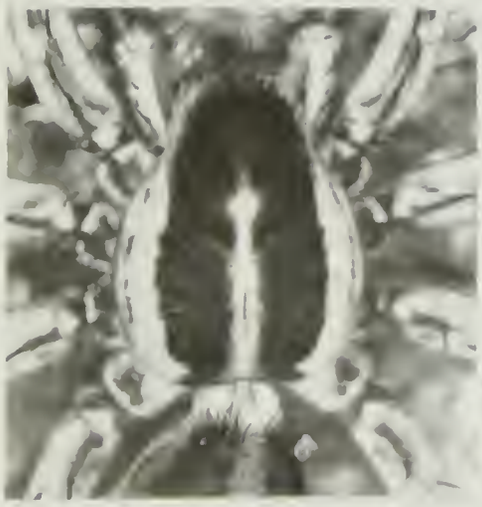


Abb. 1: Exemplar A1, Prosoma
Fig. 1: Prosoma of specimen A1

Abb. 2: Exemplar A2, Prosoma
Fig. 2: Prosoma of specimen A2

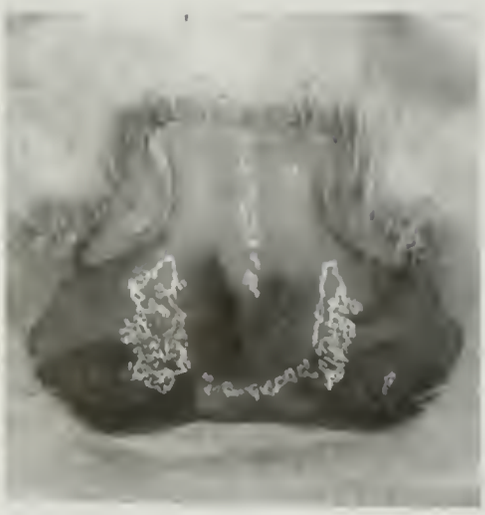


Abb. 3: Exemplar N, Epigyne
Fig. 3: Specimen N, epigyne

Abb. 4: Exemplar A1, Epigyne
Fig. 4: Specimen A1, epigyne

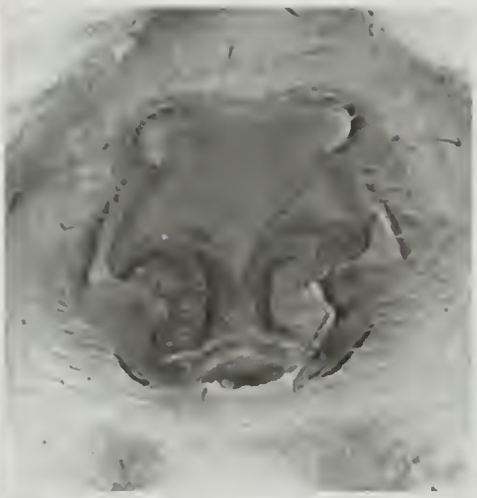


Abb. 5: Exemplar A2, Epigyne
Fig. 5: Specimen A2, epigyne

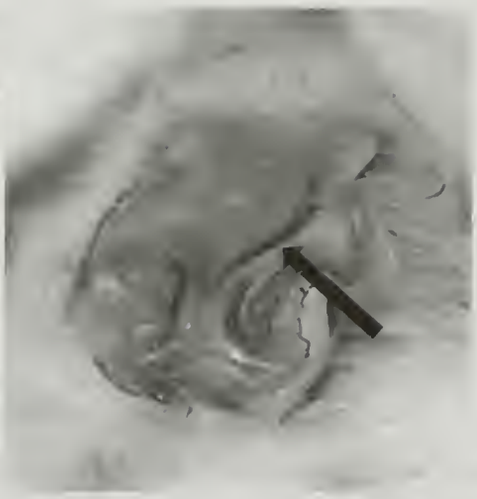


Abb. 6: Exemplar A2, Epigyne in seitlicher Ansicht (Pfeil: mögliche Bruchlinie)
Fig. 6: Specimen A2, epigyne in lateral view (arrow: possible line of breakage)

Überprüfung wurden beim Exemplar N deshalb an der separierten Epigyne die Septumflügel mit einer Mikronadel manuell entfernt. Bemerkenswerterweise brachen diese bei gezieltem Druck an einer „vorgeprägten Bruchlinie" gleichmäßig und glatt ab (Abb. 7, Pfeil). Das daraus resultierende Epigynenpräparat ähnelt stark den Abbildungen bei Bergthaler (1997) (Abb. 8 und Abb. 9).

Diskussion

Die Hintergründe der eigenartigen Epigynenausprägungen bleiben unklar. Es kommen mehrere Hypothesen in Frage.

1. Teratologische Missbildungen

Morphologische Aberrationen sind bei Spinnen in vielfältiger Form bekannt. Am häufigsten betroffen sind die Augen, die in Zahl, Form und Anordnung von der Norm abweichen können (Kaston 1962, Jiménez & Llinas 2002). In der Ontogenese können weitere gravierende, aber in der Regel nicht überlebensfähige Fehlentwicklungen auftreten (z. B. Napiórkowska & Templin 2012).

Missbildungen der Kopulationsorgane sind extrem selten (Jocqué 2002) und meistens auf Gynandromorphismus und Intersexualität zurück zu führen (Holm 1941, Kaston 1961). Kaston (1963a, 1963b)

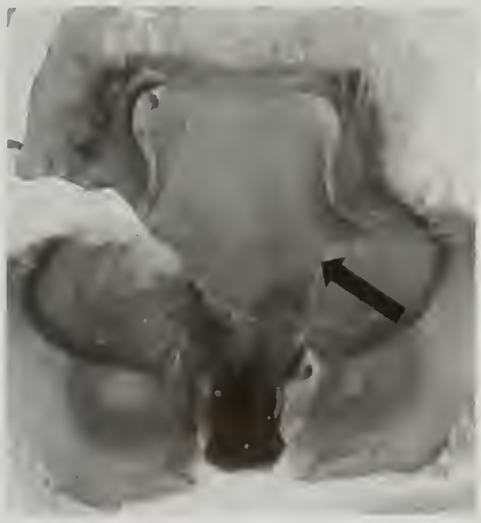


Abb. 7: Exemplar N, Epigyne nach Entfernung der Septumflügel (Pfeil: Bruchkante)
Fig. 7: Specimen N, epigyne after removal of the posterior wings of the septum (arrow: line of breakage)

Abb. 8: Bergthaler A, Epigyne (aus Bergthaler 1997)
Fig. 8: Epigyne Bergthaler A (after Bergthaler 1997)

Abb. 9: Bergthaler B, Epigyne (aus Bergthaler 1997)
Fig. 9: Bergthaler B, epigyne (after Bergthaler 1997)

beschreibt darüber hinaus asymmetrisch deformierte bzw. nur halbseitig ausgebildeter oder gar doppelt angelegte Epigynen bei Lycosiden.

Das mehrfache Auftreten und der symmetrische Bau der vorliegenden Epigynenaberration sprechen gegen eine Missbildung.

2. Einwirkung von Umweltgiften

Über teratogene Wirkungen von Umweltgiften und Pestiziden auf Spinnen liegen bislang keine Erkenntnisse vor. Allerdings sind ethologische Beeinträchtigungen z. B. des Fortpflanzungsverhaltens bei Lycosiden bekannt (Tietjen 2006).

3. Regenerationsprozesse

Durch unvollständige Regenerationsprozesse bilden Spinnenmännchen nach prämaturen Tasterverletzungen stark deformierte Kopulationsorgane aus (Kaston 1963a). Über Regenerationsprozesse nach Verletzungen subadulter Weibchen im Epigynenbereich ist nichts bekannt.

4. Parasitierung

Als Endoparasiten bei Spinnen treten vor allem Nematoden (Poinar 1987) und Dipteren (Schlinger 1987) auf. Der Befall besonders mit Mermithiden (Nematoda) kann morphische Auswirkungen auf die betroffenen Spinnenexemplare haben (Poinar 1985). Leech (1966) erwähnt auch Veränderungen an der Epigyne bei *Pardosa glacialis*. Bei Araneiden wurden Mermithiden auch im Bereich der Epigyne gefunden (van den Berg & Dippenaar-Schoemann 2009).

Obwohl äußerlich keine Hinweise auf eine Parasitierung der untersuchten Tiere zu finden sind, bleibt auch diese Ursache für die Aberrationen im Bereich des Möglichen.

5. Kopulatorische Verstümmelungen („genital damage")

Die aberranten Epigynenbilder sowohl der hier vorgestellten *Pardosa*-Weibchen als auch der Exemplare von Bergthaler (1997) sind durch das Fehlen der hinteren Septumflügel gekennzeichnet. Besonders das Exemplar A2 sowie auch das Ergebnis der Epigynen-Manipulation legen den Verdacht nahe, dass diese Septumteile abgebrochen sein könnten. Möglicherweise liegt hier ein Fall von „genital damage" vor, d. h. eine Verstümmelung der Fortpflanzungsorgane bei der Kopulation.

Während ein Abbrechen von Teilen der Kopulationsorgane bei Spinnenmännchen als regulärer Bestandteil des Begattungsverhaltens mehrfach nachgewiesen wurde (z. B. Jäger 2012), gibt es auf kopulatorische Verstümmelungen der Epigyne der Weibchen nur wenige Hinweise (Levi 1970, Gray & Smith 2008). Bei Lycosiden ist genital damage bislang allerdings nicht bekannt.

Trotz des mehrfachen Belegs tritt die beschriebene Aberration bei der sehr häufigen Art *Pardosa palustris* extrem selten auf (im vorliegenden Untersuchungsmaterial bei 0,06 % der Weibchen). Falls das Herausbrechen der Septumflügel als „genital damage" während der Paarung auftreten sollte, ist es damit eher als Ausnahme-(Un)fall zu werten. Möglicherweise sind die betroffenen Weibchen im Bau ihrer Epigyne (teratologisch?) dafür besonders prädisponiert (Bruchlinie, Abb. 7).

6. Hybridisation

Unter Laborbedingungen können speziell bei Lycosiden heterospezifische Paarungen beobachtet werden (z. B. Kronestedt 1994). Sehr nahe verwandte Arten bringen dabei überlebensfähige Hybriden hervor (Costa et al. 2000), deren Koplationsorgane intermediäre Merkmale aufweisen (Simo et al. 2002). Ein völlig neues Epigynenbild erscheint dabei ausgeschlossen.

7. Bislang unbekannte Art

Das mehrfache Auftreten der sehr aberranten Epigynenform lässt auch diese Möglichkeit offen. Allerdings fehlen bislang Hinweise auf die zugehörigen Männchen sowie auf verwandte Arten. Lediglich die in nur einem Exemplar bekannte *Pardosa danica* (Sørensen, 1904) weist eine gewisse Ähnlichkeit im Epigynenbau auf (Wolff & Scharff 2003). Da neben dem Typusexemplar keine weiteren Nachweise vorliegen, ist auch hier eher an eine singuläre Fehlbildung zu denken.

Eine endgültige Klärung des Phänomens bleibt deshalb mit dem Auffinden weiterer vergleichbarer Fälle der Zukunft vorbehalten.

Danksagung

Ich danke Herrn Theo Blick für Hinweise und seine Unterstützung bei der Literatur-Beschaffung. Mein besonderer Dank gilt den Gutachtern für ihre wertvollen kritischen Anmerkungen.

Literatur

Beaumont D 1991 Atypical *Pardosa amentata* (Clerck, 1757) males from the Isle of Islay, Inner Hebrides, Scotland. – Newsletter of the British arachnological Society 60: 4

Berg A van den & Dippenaar-Schoemann A 2009 First report on nematodes parasitizing spiders in South Africa. – SANSA Newsletter 10: 15

Bergthaler GJ 1997 Unusual epigynes of *Pardosa* (Araneae: Lycosidae) – aberration, hybridisation or new species? – Proceedings of the 16th European Colloqium of Arachnology: 47-49

Costa FG, Viera C & Francescoli G 2000 A comparative study of sexual behavior in two synmorphic species of the genus *Lycosa* (Araneae, Lycosidae) and their hybrid progeny. – The Journal of Arachnology 28: 237-240 – doi: 10.1636/0161-8202-(2000)028[0237:ACSOSB]2.0.CO;2

Fuhn IE & Niculescu-Burlacu F 1971 Arachnida – Fam. Lycosidae. – Fauna Republicii Socialiste România 5(3): 1-253

Gray MR & Smith HM 2008 A new subfamily of spiders with grate-shaped tapeta from Australia and Papua New Guinea (Araneae: Stiphidiidae: Borralinae). – Records of the Australian Museum 60: 13-44 – doi: 10.3853/j.0067-1975.60.2008.1493

Holm Å 1941 Über Gynandromorphismus und Intersexualität bei den Spinnen. – Zoologiska Bidrag från Uppsala 20: 397-415

Huber BA 2004 The significance of copulatory structures in spider sytematics. In: Schult J (ed.) Biosemiotik – praktische Anwendung und Konsequenzen für die Einzelwissenschaften. VWB Verlag, Berlin. S. 89-100

Jäger P 2012 A review on the spider genus *Argiope* Audouin 1826 with special emphysis on broken emboli in female epigynes (Araneae: Araneidae: Argyopinae). – Beiträge zur Araneologie 7: 272-331

Jiménez M-L & Llinas J 2002 Revision of ocular anomalies in epigean spiders (Arachnida: Araneae) with notes an four new records. – Anales del Instituto de Biología serie Zoología 73: 241-250

Jocqué R 2002 Genitalic polymorphism – a challenge for taxonomy. – The Journal of Arachnology 30: 298-306 – doi: 10.1636/0161-8202-(2002)030[0298:GPACFT]2.0.CO;2

Kaston BJ 1961 Spider gynandromorphs and intersexes. – Journal of the New York Entomological Society 69: 177-190

Kaston BJ 1962 Ocular anomalies in spiders. – Bulletin of the Brooklyn Entomological Society 57: 17-21

Kaston BJ 1963a Deformities of external genitalia in spiders. – Journal of the New York Entomological Society 71: 30-39

Kaston BJ 1963b Abnormal duplication of the epigynum and other structural anomalies in spiders. – Transactions of the American Microscopical Society 82: 220-223

Kronestedt T 1994 A case of heterospecific mating in wolf spiders (Araneae, Lycosidae). – The Journal of Arachnology 22: 84-86

Levi HW 1970 The *ravilla* group of the orbweaver genus *Eriophora* in North America (Araneae: Araneidae). – Psyche 77: 280-302 – doi: 10.1155/1970/69275

Napiórkowska T & Templin J 2012 Pająki w badaniach teratologicznych. – Kosmos – Problemy nauk biologicznych 61: 455-465

Nentwig W, Blick T, Gloor D, Hänggi A & Kropf C 2013 Spinnen Europas, Version 04.2013 – Internet: http://www.araneae.unibe.ch (20.4.2013)

Poinar GO 1985 Mermithid (Nematodes) parasites of spiders and harvestmen. – The Journal of Arachnology 13: 121-128

Poinar GO 1987 Nematode parasites of spiders. In: Nentwig W (ed.) Ecophysiology of spiders. Springer, Heidelberg. pp. 299-308

Schlinger EI 1987 The biology of Acroceridae (Diptera): true endoparasitoids of spiders. In: Nentwig W (ed.) Ecophysiology of spiders. Springer, Heidelberg. pp. 319-327

Simó M, Segui T & Perez-Miles F 2002 The copulatory organs of the cryptic species *Lycosa thorelli* and *Lycosa carbonelli* and their hybrid progeny, with notes on their taxonomy (Araneae, Lycosidae). – The Journal of Arachnology 30: 140-145 – doi: 10.1636/0161-8202-(2002)030[0140:TCOOTC]2.0.CO;2

Tambs-Lyche H 1941 Die norwegischen Spinnen der Gattung *Pardosa* Koch. –Avhandlinger utgitt av det Norske Videnskaps-Akademie i Oslo 1: 1-59

Tietjen WJ 2006 Pesticides affect the mating behavior of *Rabidosa rabida* (Araneae, Lycosidae). – The Journal of Arachnology 34: 285-288 – doi: 10.1636/S04-50.1

Tongiorgi P 1966a Wolf spiders of the *Pardosa monticola* group (Araneae, Lycosidae). – Bulletin of the Museum of Comparative Zoology 134: 335-359

Tongiorgi P 1966b Italian wolf spiders of the genus *Pardosa* (Araneae: Lycosidae). – Bulletin of the Museum of Comparative Zoology 134: 275-334

Wolff T & Scharff N 2003 Gåder om mudderkrebs og jagtedderkop. – Dyr i Natur og Museum 2003 (2): 24-27

Menemerus fagei new to Malta and Europe (Araneae: Salticidae)

Mario Freudenschuss, Tobias Bauer & Arnold Sciberras

doi: 10.5431/aramit4602

Abstract. The first record of *Menemerus fagei* Berland & Millot 1941 (Araneae, Salticidae) from the Maltese Islands is reported and discussed. It is the 20th jumping spider species for Malta and a new record for Europe.

Keywords: Gozo, jumping spider, Maltese Islands

The Maltese islands are located in the centre of the Mediterranean, 96 km south of Sicily and 290 km from the coast of North Africa (Baldacchino et al. 1993). The Maltese archipelago consists of three large islands (Malta, Gozo and Comino). The total size of the Maltese islands is 316 km^2. The geographical location of the Maltese islands gives them unique ecological characteristics, since the islands are located between Africa and Europe. They thus comprise a mixture of the biodiversity from both continents. European taxa dominate, but there are North African elements as well (Sciberras & Sciberras 2010, Sciberras et al. 2012a, 2012b).

The hitherto known spider fauna of the Maltese Islands comprises only 137 species in 31 families, including seven endemic species (Dandria et al. 2005). Salticidae are represented by 19 species. One species of this family has a very small distribution area: *Aelurillus schembrii* Cantarella, 1983). It has only been recorded from Malta and Sicily so far (Dandria et al. 2005).

Here we present a new species record of jumping spiders for Malta and Europe. The specimen in question was found on the island of Gozo. Photographs of the habitus and genitalia are presented (Figs 1-3). The specimen was identified using the revision of the spider genus *Menemerus* in Africa (Wesołowska 1999) and is deposited at the private collection of the first author.

Menemerus fagei Berland & Millot, 1941

1♀, Malta, Gozo, Ghajnsielen (N36°01´12.27" E14°17´23.84"), 28.04.2012 (leg. A. Sciberras), (Fig. 4), 15 m a.s.l., Xatt l-Ahmar pocket Beach, under *Limbarda crithmoides* in a clayish habitat (Fig. 5), M. Freudenschuss det., W. Wesołowska vid.

Fig. 1: *Menemerus fagei*, habitus dorsal. – Photo: M. Freudenschuss

Fig. 2: *Menemerus fagei*, habitus lateral. – Photo: M. Freudenschuss

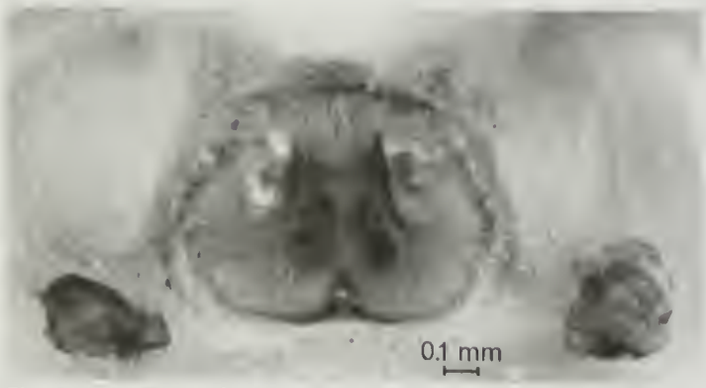


Fig. 3: *Menemerus fagei*, epigyne ventral. – Photo: M. Freudenschuss

Mario FREUDENSCHUSS, Siegfriedstraße 1/3/31, 4300 St. Valentin, Austria, e-mail: mario.freudenschuss@gmail.com
Tobias BAUER, Marbacher Straße 5, 70435 Stuttgart, Germany, e-mail: tobias_bauer@hotmail.de
Arnold SCIBERRAS, Arnest Arcade street 133, Paola, Malta, e-mail: bioislets@gmail.com

submitted 14.8.13, accepted 8.9.13, online 18.9.13

Fig. 4: Map of Gozo with collection area.

Fig. 5: Locality of *Menemerus fagei*. – Photo: A. Sciberras

Diagnosis

This species is one of the largest in the genus. Our specimen has a body length of 11.4 mm. The female is much larger than the male (Wesołowska 1999); colouration like the male but slightly lighter. Legs yellowish. Epigyne large, with two oval depressions. Partially plugged with waxy secretions (Fig. 3). Internal structures very strongly sclerotized, especially the entrance bowls (Fig. 3 and Wesołowska 1999). The epigynum does not resemble any other known female *Menemerus* species, thus confusion with other species of the genus can be excluded.

Comments

Berland & Millot (1941) described this species on the basis of the female. The male was described by Wesołowska (1999). Prószyński (1989: sub *M. bivittatus*) published drawings of both sexes, but subsequently attached them to *M. fagei* (Prószyński 2003).

Distribution

The known distribution range of the species is from West Africa to Yemen (Platnick 2013). The closest records to our find are from Israel (Prószyński 2003) and Egypt (Wesołowska 1999).

Discussion

With 70 species, *Menemerus* a moderately species-rich genus within the salticids. The genus is distributed worldwide. The majority of the species have been recorded from Africa, with only a few species in Europe (total distribution according to Platnick 2013 and European country records according to Nentwig et al 2013):

- *M. animatus* O. P.-Cambridge, 1976: Greece
- *M. bivittatus* (Dufour, 1831): Senegal to Iraq; Europe: France, Italy, Portugal, Spain
- *M. dimidius* (Schmidt, 1976): Canary Is. [politically to Europe, but not geographically]
- *M. falsificus* Simon, 1868: Southern Europe: Bulgaria, Croatia, France, Switzerland
- *M. illigeri* (Audouin, 1826): Portugal, North Africa, Middle East, St. Helena
- *M. schutzae* Denis, 1961 [only the female is known]: France [the species is valid according to Platnick 2013, but considered a synonym of *Marpissa radiata* (Grube, 1859) in Prószyński 2013]
- *M. semilimbatus* (Hahn, 1829) [type species of the genus]: Canary Is. to Azerbaijan; Chile, Argentina, USA (introduced); Europe: Albania, Belarus, Bulgaria, Croatia, France, Greece, Italy, Macedonia, Moldavia, Portugal, Romania, Spain, Slovenia, Ukraine
- *M. taeniatus* (L. Koch, 1867): Mediterranean to Kazakhstan; Argentina [presumably introduced]; Europe: Bulgaria, Croatia, France, Greece, Italy, Portugal, Romania, Spain, Ukraine

With *M. fagei* we present a new species for Europe. The closest published record is from Egypt, the northernmost is from Israel. The new record from Malta supports the assumption that the species is more widespread in northern Africa. The epigynum of the females from Israel and Egypt differ slightly (Prószyński 2013). The specimen from Malta is of the African type. The species has already been collected in the west-Mediterranean sub-region (Wesołowska 1999), but these records have not yet been published (Wesołowska pers. comm.). For Malta this is the 20th species of jumping spiders.

Acknowledgements
We are grateful to Theo Blick for his valuable comments on earlier drafts of the manuscript and to Wanda Wesolowska for her comments and for her validation of the determination.

References

Baldacchino AE, Dandria D, Lanfranco E & Schembri PJ 1993 Records of spiders (Arachnida: Araneae) from the Maltese islands (Central Mediterranean). – The Central Mediterranean Naturalist 2: 37-59

Berland L & Millot J 1941 Les araignées de l'Afrique occidentale française. I. Les Salticides. – Mémoires du Muséum National d'Histoire Naturelle, Paris 12: 297-421

Dandria D, Falzon V & Henwood J 2005 The current knowledge of the spider fauna of the Maltese Islands, with the addition of some new records (Arachnida: Araneae). – The Central Mediterranean Naturalist 4: 121-130

Metzner H 2013 Jumping spiders (Arachnida: Araneae: Salticidae) of the world. – Internet: http://www.jumping-spiders.com (Aug. 12, 2013)

Nentwig W, Blick T, Gloor D, Hänggi A & Kropf C 2013 araneae – Spinnen Europas. – Internet: http://www.araneae.unibe.ch (Aug. 12, 2013)

Platnick NI 2013 The world spider catalog, version 14.0. American Museum of Natural History, New York. – Internet: http://research.amnh.org/iz/spiders/catalog (Aug. 12, 2013)

Prószyński J 1989 Salticidae (Araneae) of Saudi Arabia. – Fauna of Saudi Arabia 10: 31-64

Prószyński J 2003 Salticidae (Araneae) of the Levant. – Annales Zoologici (Warszawa) 53: 1-180

Prószyński J 2013 Monograph of the Salticidae (Araneae) of the world 1995-2013. – Internet: http://www.peckhamia.com/salticidae (Aug. 12, 2013)

Rakov S & Logunov D 1997 Taxonomic notes on the genus *Menemerus* Simon, 1868 in the fauna of Middle Asia (Araneae, Salticidae). – Proceedings of the European Colloquium of Arachnology 16: 271-279

Sciberras A, Sciberras J, Sammut M & Aloise G 2012a A contribution to the knowledge of the terrestrial mammalian fauna of Comino and its satellite islets (Maltese archipelago). – Biodiversity Journal 3: 191-200

Sciberras J & Sciberras A 2010 Topography and flora of the satellite islets surrounding the Maltese Archipelago. – The Central Mediterranean Naturalist 5: 31-42

Sciberras J, Sciberras A & Pisani L 2012b Updated checklist of flora of the satellite islets surrounding the Maltese archipelago. – Biodiversity Journal 3: 385-396

Wesolowska W 1999 A revision of the spiders genus *Menemerus* in Africa (Araneae: Salticidae). – Genus 10: 251-353

First record of the genus *Megachernes* (Pseudoscorpiones: Chernetidae) from an Iranian cave

Jana Christophoryová, Selvin Dashdamirov, Mohammad Javad Malek Hosseini & Saber Sadeghi

doi: 10.5431/aramit4603

Abstract. The pseudoscorpion genus *Megachernes* is recorded for the first time in Iran. Adults and protonymphs of *Megachernes pavlovskyi* Redikorzev, 1949 were found in a porcupine nest and under stones in the Deh Sheikh (Pataveh) cave, Kohgiluyeh and Boyer-Ahmad Province, Southwest Iran. A short description of the species is provided, based on the main morphological and morphometric characters of the adults.

Keywords: cave, Iran, new record, porcupine nest, pseudoscorpion, Southern Asia, taxonomy

Pseudoscorpions in the family Chernetidae Menge, 1855 are found all over the world, occurring under tree bark, in nests, leaf litter and caves, as well as in a variety of other habitats. Three subfamilies are recognized – Chernetinae Menge, 1855, Goniochernetinae Beier, 1932 and Lamprochernetinae Beier, 1932 – but their status and interrelationships are still very poorly understood (Harvey 2011). Lamprochernetinae can be recognized by the structure of the female spermathecae, which are basically T-shaped. Thirty-nine pseudoscorpion species were recorded from Iran, eight of them are representatives of the family Chernetidae (Harvey 2011).

The genus *Megachernes* Beier, 1932, currently encompassing twenty-three species, occurs in Asia, Australia and the European part of Russia (Harvey 2011, Harvey et al. 2012). *Megachernes* species are usually associated with small mammals, their nests or pelage, but they have also been found in nests of birds and bumblebees, and some are troglophiles found in caves, frequently on bat guano (Beier 1948, Schawaller & Dashdamirov 1988, Harvey et al. 2012). Most species of this genus are only known from a single country (Harvey 2011), but this is probably due to under-collecting and it is likely that the distribution of many species is much broader. An exception is *M. pavlovskyi* Redikorzev, 1949, which is known to have a particularly wide distribution: Afghanistan, Azerbaijan, Kyrgyzstan, Pakistan, Russia, Tajikistan and Turkmenistan (Harvey 2011). This species is mostly found on bat guano in caves (Beier 1959, Krumpál 1986, Schawaller 1986, Schawaller & Dashdamirov 1988, Dashdamirov & Schawaller 1995). *Megachernes pavlovskyi* is here recorded in Iran for the first time, having been discovered in the nest of a porcupine, *Hystrix indica* (Keep, 1792).

Jana CHRISTOPHORYOVÁ, Department of Zoology, Faculty of Natural Sciences, Comenius University, Mlynská dolina B-1, SK–84215 Bratislava, Slovak Republic; E-mail: christophoryova@gmail.com
Selvin DASHDAMIROV, Institut für Zoomorphologie, Zellbiologie und Parasitologie Heinrich-Heine- Universität, Universitätsstr. 1, 40225 Düsseldorf, Germany.
Mohammad Javad MALEK HOSSEINI, Saber SADEGHI, Department of Biology, Faculty of Sciences, Shiraz University, Shiraz, Iran; E-mails: malekhosseini1365@gmail.com, ssadeghi@shirazu.ac.ir

submitted 26.6.13, accepted 18.9.13, online 2.10.13

Material and methods

Specimens were preserved in 70% ethanol; some were studied as permanent slide mounts in Swan's fluid and the others as temporary slide mounts in lactic acid (det. Christophoryová, the identification confirmed by S. Dashdamirov). Microphotographs were made using the EOS Utility software and a digital camera (Canon EOS 1100D) connected to a Zeiss Stemi 2000-C stereomicroscope. The female genitalia were dissected in ethanol and macerated using a NaOH solution, then mounted on a permanent slide in Swan's fluid. Microslides of the spermathecae were photographed using a Leica ICC50 camera connected to a Leica DM1000 microscope, using Leica LAS EZ 1.8.0 software. Digital images were combined using the CombineZP image stacking software. All measurements were obtained using AxioVision 4.8.2. Part of the material is deposited in the collection of the first author at the Comenius University, Bratislava, and the rest in the collection of Department of Biology at Shiraz University, Iran (CBSU-Ar-Ps.1). Morphological terminology follows Beier (1963), Harvey (1992) and Judson (2007).

Results

Megachernes pavlovskyi Redikorzev, 1949

The species has been described under two names: *Megachernes pavlovskyi* Redikorzev, 1949: 651-652 (Redikorzev 1949), 274 (Beier 1959), 31 (Lindberg 1961), 3 (Schawaller 1986), 43 (Schawaller & Da-

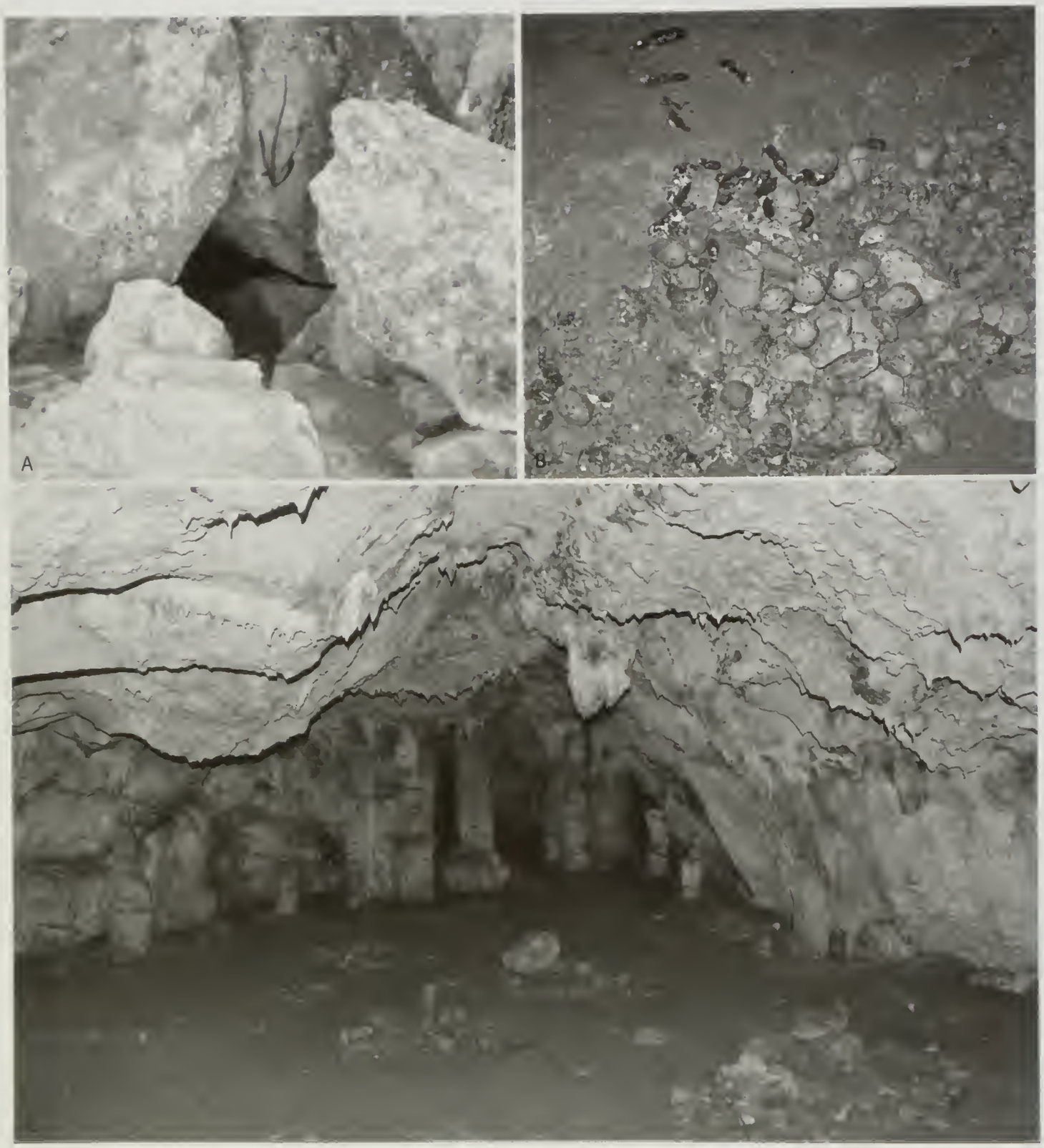


Fig. 1: Deh Sheikh cave, in which *Megachernes pavlovskyi* was found. A. Cave entrance. B. Detail of porcupine den. C. Cave interior. – Photos: Mohammad Javad Malek Hosseini.

shdamirov 1988), 600-601 (Harvey 1991), 56 (Dashdamirov & Schawaller 1992), 8 (Dashdamirov & Schawaller 1995), 258-259 (Dashdamirov 2004), 2530 (Harvey et al. 2012).

Megachernes caucasicus Krumpál, 1986: 170-171 (Krumpál 1986); synonymised by Schawaller & Dashdamirov (1988).

Material examined

The pseudoscorpions were collected individually under stones and in a porcupine nest in the aphotic (dark) zone (about 70–80 m from the main entrance) of the Deh Sheikh (Pataveh) cave, by Malek Hosseini & Sadeghi. Several specimens were taken there, 11 of which (27.9.2011: 3 females, 1 male, 2 protonymphs; 13.7.2012:

Fig. 2: *Megachernes pavlovskyi* from Deh Sheikh cave. A. Female. B. Male. Scale: 1 mm. – Photos: Jana Christophoryová.

1 female, 4 males) were examined in detail. The cave is situated in the mountains around the village of Dehsheikh, north-west of the city of Yasuj, in Kohgiluyeh and Boyer-Ahmad Province (30°57′22″N; 51°14′17″E; 1735 m a.s.l.; Fig. 1). The temperature inside the cave is constant, about 15.5–16.5 °C. The relative humidity was measured only on the visiting days; its values were between 72 and 84 %. Unfortunately, due to human activities, some parts of the Deh Sheikh cave have been destroyed and animal life here is endangered.

Short description of adults (Fig. 2)

The genus *Megachernes*, subfamily Lamprochernetinae, is characterized by the following characters (Fig. 3): posterior corners of coxae IV enlarged and rounded, lobe-shaped, better developed in females; cheliceral rallum of three blades; tarsus IV with a long tactile seta situated in middle of segment; and female spermathecae T-shaped and with very long ends uniform in diameter and slightly expanded terminally (Harvey et al. 2012).

Adults of both sexes were measured; the measurements and ratios are summarised in Tables 1 and 2.

Females (4 specimens)

Carapace and pedipalps reddish-brown, tergites and sternites brown (Fig. 2A). Carapace: about as long as broad, broadest posteriorly, anterior margin straight; eyes or eyespots completely absent; with two distinct transverse furrows; chaetotaxy of carapace: about 68–75 short setae, finely dentate apically, about 8–9 of which noticeably longer than others on anterior margin, about 40–48 in front of median transverse furrow and about 11–13 behind subbasal transverse furrow; many slit-like lyrifissures present over entire carapace. Chelicerae with 4 retrorse teeth on fixed finger; 7 setae on hand, basal 5 finely dentate apically, movable finger with one acuminate seta; galea well-developed, with approximately 9–10 short terminal and subterminal branches; rallum with three blades. Pedipalps (Fig. 2A): robust, well-sclerotized, with well-developed granulation; chelal finger longer than hand width; chelal fingers with normal number of trichobothria – 8 on fixed finger, 4 on movable finger; trichobothrial pattern identical to that described by previous authors (Krumpál 1986, Dashdamirov & Schawaller 1995, Dashdamirov 2004); venom appa-

Tab. 1: Morphometric data for *Megachernes pavlovskyi* females (in mm).

Characteristics	min	max	x	M	SD	n
Body, length	3.54	4.55	3.99	3.88	0.51	3
Carapace, length	1.07	1.24	1.16	1.16	0.08	4
Carapace, posterior width	1.08	1.23	1.15	1.15	0.07	4
Carapace, length/posterior width ratio	0.99	1.18	1.09	1.10	0.08	4
Chelicera, length	0.32	0.33	0.32	0.32	0.01	3
Chelicera, width	0.15	0.16	0.16	0.16	0.01	3
Chelicera, length/width ratio	2.06	2.13	2.08	2.06	0.04	3
Cheliceral movable finger, length	0.25	0.29	0.27	0.26	0.02	3
Palpal trochanter, length	0.54	0.57	0.55	0.55	0.01	4
Palpal trochanter, width	0.34	0.38	0.36	0.35	0.02	4
Palpal trochanter, length/width ratio	1.50	1.62	1.55	1.54	0.05	4
Palpal femur, length	0.99	1.20	1.13	1.16	0.09	4
Palpal femur, width	0.32	0.39	0.36	0.37	0.03	4
Palpal femur, length/width ratio	3.03	3.22	3.10	3.09	0.08	4
Palpal patella, length	0.94	1.07	1.02	1.04	0.06	4
Palpal patella, width	0.38	0.45	0.42	0.42	0.03	4
Palpal patella, length/width ratio	2.29	2.68	2.46	2.45	0.16	4
Palpal hand with pedicel, length	0.93	1.11	1.02	1.01	0.08	4
Palpal hand without pedicel, length	0.80	0.97	0.89	0.89	0.07	4
Palpal hand, width	0.53	0.66	0.61	0.62	0.05	4
Palpal hand with pedicel, length/width ratio	1.61	1.75	1.68	1.68	0.06	4
Palpal finger, length	0.87	1.00	0.96	0.99	0.06	4
Palpal chela, length	1.67	1.93	1.85	1.90	0.12	4
Palpal chela, length/palpal hand width	2.86	3.15	3.06	3.11	0.13	4
Leg I trochanter, length	0.23	0.26	0.25	0.26	0.01	4
Leg I trochanter, width	0.15	0.18	0.17	0.17	0.01	4
Leg I trochanter, length/width ratio	1.44	1.53	1.49	1.50	0.04	4
Leg I femur I, length	0.26	0.29	0.28	0.29	0.01	4
Leg I femur I, width	0.16	0.20	0.18	0.19	0.02	4
Leg I femur I, length/width ratio	1.45	1.63	1.54	1.54	0.07	4
Leg I femur II, length	0.50	0.57	0.54	0.55	0.03	4
Leg I femur II, width	0.15	0.19	0.17	0.17	0.02	4
Leg I femur II, length/width ratio	2.89	3.67	3.26	3.24	0.33	4
Leg I tibia, length	0.53	0.62	0.59	0.61	0.04	4
Leg I tibia, width	0.11	0.12	0.12	0.12	0.01	4
Leg I tibia, length/width ratio	4.82	5.45	5.13	5.13	0.26	4
Leg I tarsus, length	0.43	0.52	0.49	0.50	0.04	4
Leg I tarsus, width	0.08	0.09	0.09	0.09	0.01	4
Leg I tarsus, length/width ratio	5.00	5.78	5.43	5.47	0.33	4
Leg IV trochanter, length	0.29	0.39	0.35	0.37	0.05	3
Leg IV trochanter, width	0.17	0.21	0.19	0.18	0.02	3
Leg IV trochanter, length/width ratio	1.71	2.06	1.88	1.86	0.18	3
Leg IV femur, length	0.95	1.09	1.05	1.07	0.06	4
Leg IV femur, width	0.18	0.24	0.21	0.21	0.03	4
Leg IV femur, length/width ratio	4.54	5.63	5.03	4.97	0.52	4
Leg IV tibia, length	0.82	0.97	0.91	0.93	0.07	4
Leg IV tibia, width	0.14	0.15	0.14	0.14	0.00	4
Leg IV tibia, length/width ratio	5.86	6.93	6.39	6.38	0.44	4
Leg IV tarsus, length	0.54	0.63	0.60	0.62	0.04	4
Leg IV tarsus, width	0.11	0.12	0.11	0.11	0.01	4
Leg IV tarsus, length/width ratio	4.50	5.73	5.38	5.64	0.59	4

Abbreviations: min – minimum, max – maximum, x – arithmetic mean, M – median, SD – standard deviation, n – number of individuals measured.

Tab. 2: Morphometric data for *Megachernes pavlovskyi* males (in mm).

Characteristics	min	max	x	M	SD	n
Body, length	3.19	3.76	3.46	3.54	0.24	5
Carapace, length	1.08	1.16	1.12	1.13	0.03	5
Carapace, posterior width	1.03	1.12	1.06	1.05	0.04	5
Carapace, length/posterior width ratio	0.98	1.12	1.09	1.11	0.06	5
Chelicera, length	0.31	0.33	0.32	0.31	0.01	5
Chelicera, width	0.15	0.16	0.16	0.16	0.01	5
Chelicera, length/width ratio	1.94	2.07	2.03	2.06	0.06	5
Cheliceral movable finger, length	0.26	0.28	0.27	0.28	0.01	5
Palpal trochanter, length	0.54	0.62	0.59	0.59	0.03	5
Palpal trochanter, width	0.32	0.39	0.37	0.38	0.03	5
Palpal trochanter, length/width ratio	1.49	1.69	1.59	1.62	0.08	5
Palpal femur, length	1.02	1.09	1.06	1.05	0.03	5
Palpal femur, width	0.35	0.38	0.36	0.36	0.01	5
Palpal femur, length/width ratio	2.84	3.03	2.92	2.91	0.08	5
Palpal patella, length	0.92	1.10	1.01	1.02	0.07	5
Palpal patella, width	0.40	0.45	0.42	0.41	0.02	5
Palpal patella, length/width ratio	2.24	2.49	2.41	2.44	0.10	5
Palpal hand with pedicel, length	0.91	1.03	0.98	1.02	0.06	5
Palpal hand without pedicel, length	0.77	0.90	0.84	0.85	0.05	5
Palpal hand, width	0.56	0.63	0.59	0.57	0.03	5
Palpal hand with pedicel, length/width ratio	1.63	1.79	1.68	1.66	0.07	5
Palpal finger, length	0.87	0.96	0.91	0.91	0.03	5
Palpal chela, length	1.73	1.82	1.78	1.80	0.04	5
Palpal chela, length/palpal hand width	2.87	3.16	3.04	3.09	0.11	5
Leg I trochanter, length	0.22	0.25	0.24	0.24	0.02	5
Leg I trochanter, width	0.16	0.18	0.17	0.17	0.01	5
Leg I trochanter, length/width ratio	1.33	1.47	1.39	1.38	0.05	5
Leg I femur I, length	0.26	0.31	0.29	0.30	0.02	4
Leg I femur I, width	0.17	0.19	0.18	0.18	0.01	5
Leg I femur I, length/width ratio	1.53	1.63	1.60	1.62	0.05	4
Leg I femur II, length	0.47	0.56	0.52	0.53	0.04	4
Leg I femur II, width	0.16	0.17	0.17	0.17	0.01	5
Leg I femur II, length/width ratio	2.76	3.29	3.10	3.18	0.24	4
Leg I tibia, length	0.56	0.62	0.58	0.58	0.02	5
Leg I tibia, width	0.10	0.12	0.11	0.11	0.01	5
Leg I tibia, length/width ratio	4.67	5.64	5.22	5.27	0.42	5
Leg I tarsus, length	0.41	0.50	0.47	0.50	0.04	5
Leg I tarsus, width	0.08	0.10	0.09	0.09	0.01	5
Leg I tarsus, length/width ratio	5.00	5.56	5.25	5.13	0.29	5
Leg IV trochanter, length	0.31	0.41	0.35	0.33	0.04	5
Leg IV trochanter, width	0.17	0.22	0.19	0.18	0.02	5
Leg IV trochanter, length/width ratio	1.63	2.11	1.89	1.88	0.17	5
Leg IV femur, length	0.95	1.06	1.01	1.04	0.05	5
Leg IV femur, width	0.19	0.22	0.20	0.20	0.01	5
Leg IV femur, length/width ratio	4.73	5.25	4.98	5.05	0.23	5
Leg IV tibia, length	0.85	0.92	0.90	0.92	0.03	5
Leg IV tibia, width	0.13	0.15	0.14	0.14	0.01	5
Leg IV tibia, length/width ratio	6.13	6.69	6.50	6.57	0.21	5
Leg IV tarsus, length	0.56	0.63	0.59	0.60	0.03	5
Leg IV tarsus, width	0.11	0.12	0.11	0.11	0.00	5
Leg IV tarsus, length/width ratio	5.08	5.73	5.31	5.18	0.28	5

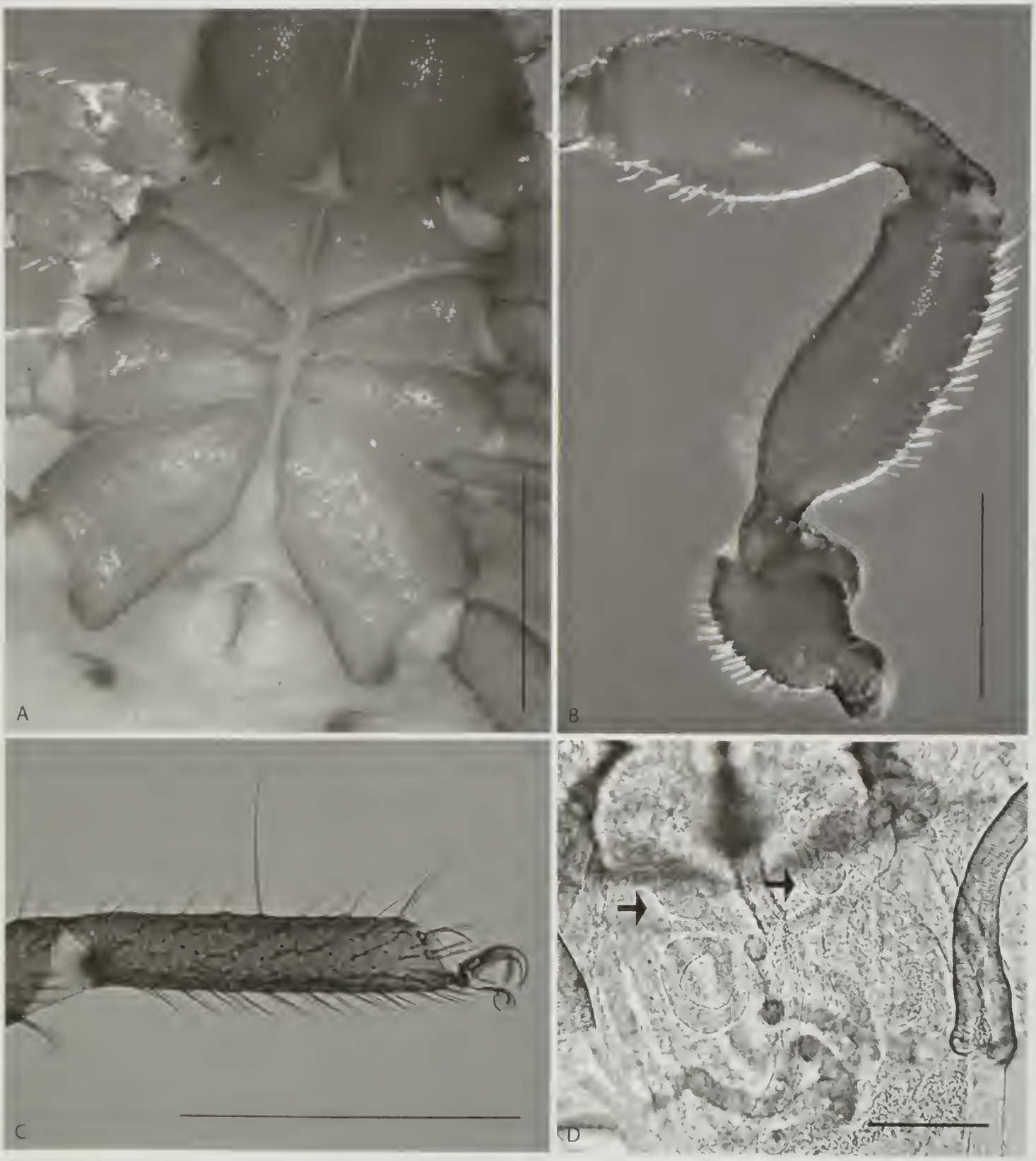


Fig. 3: Morphological characters of *Megachernes pavlovskyi*. A. Coxae, posterior corners of coxae IV (female, ventral view). B. Palpal trochanter, femur and patella (male, dorsal view). C. Tarsus IV with tactile seta (female, lateral view). D. Spermatheca (female, dorsal view). Arrows point to terminally expanded spermathecae ends. Scales: 0.2 mm (D), 0.5 mm (A, B, C). – Photos: Jana Christophoryová.

ratus developed only in movable finger, with nodus ramosus terminating between terminal trichobothrium (*t*) and subterminal trichobothrium (*st*); fixed finger with 50, movable finger with 51–54 marginal teeth; movable finger medially with 9–11 accessory teeth, fixed finger medially with 6–8 accessory teeth; movable finger laterally with 5 accessory teeth, fixed finger laterally with 9–12 accessory teeth; setae on trochanter and femur small and inconspicuous. Posterior corners of coxae IV lobe-shaped, enlarged and rounded (Fig. 3A); pedal tarsus IV with a long tactile seta situated in middle of segment (Fig. 3C). Sper-

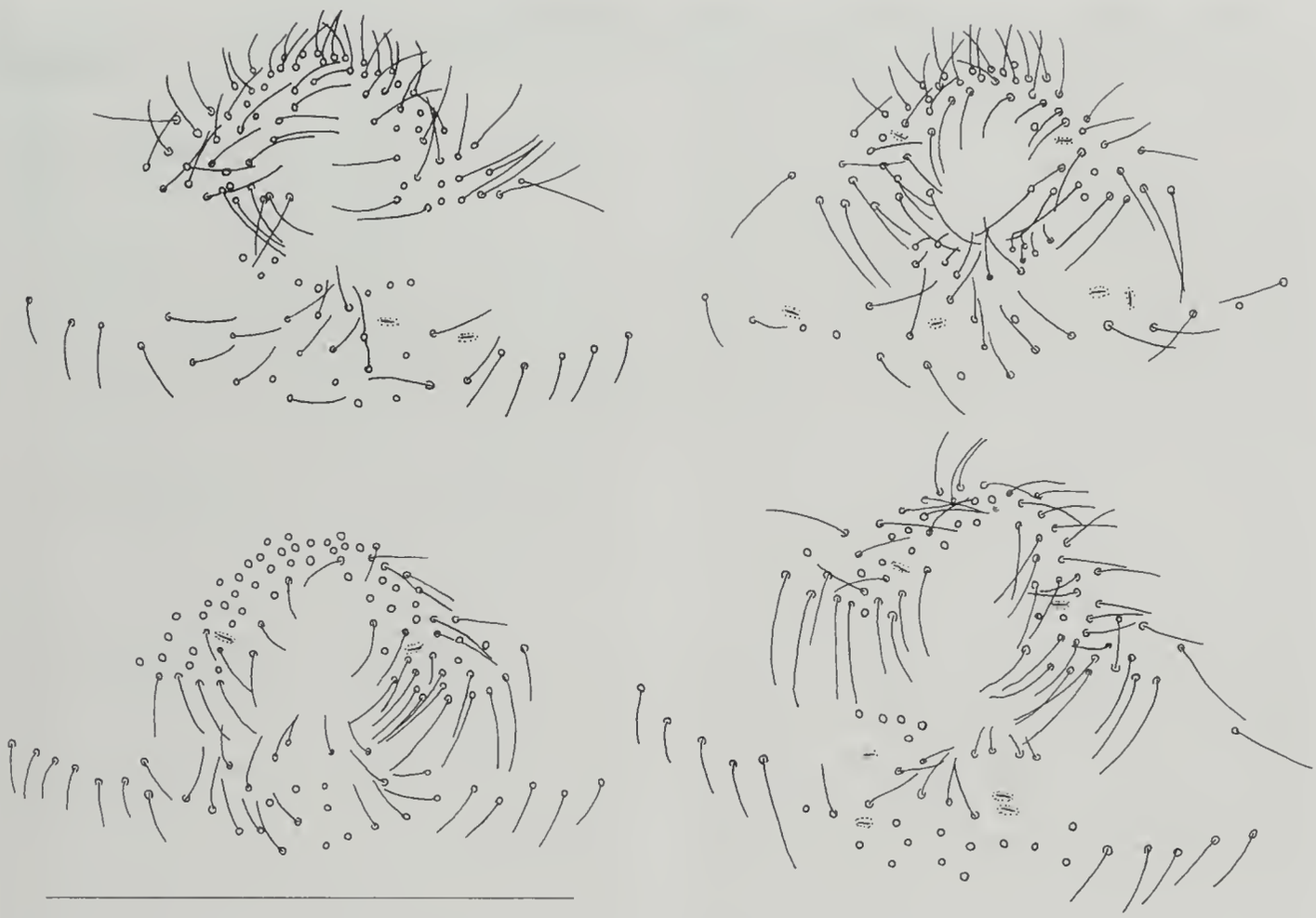


Fig. 4: Variation in the setation in the genital area of four *Megachernes pavlovskyi* males. Scale: 0.5 mm.

matheca T-shaped, with extremely elongated ends, both expanded terminally (Fig. 3D); anterior genital operculum with 35–44 acuminate and curved setae and with 2 lyrifissures, posterior genital operculum with 9–11 setae and 2 lyrifissures. Abdominal tergites: I–X distinctly divided, tergite XI undivided; chaetotaxy of tergites I–X (left+right half-tergite): 5–6+4–6: 5–6+5–6: 5–6+4–6: 5–7+5–6: 5–7+6–8: 5–8+5–8: 6–8+6–8: 5–8+5–7: 5–6+5–8: 4–5+4–6, tergite XI with 8–9 setae, including a pair of long tactile setae.

Males (five specimens)
Males differ from females by the following characters: Carapace with about 69–76 setae, of which 8–10 noticeably longer than others on anterior margin, about 40–42 in front of median transverse furrow and about 13–16 behind subbasal transverse furrow. Chelicerae with 4–5 retrorse teeth on fixed finger; galea with approximately 2–3 short branches. Pedipalps: fixed finger with 47–52, movable finger with 50–56 marginal teeth; movable finger medially with 8–11 accessory teeth, fixed finger medially with 6–7 accessory teeth; movable finger laterally with 4–5 accessory teeth, fixed finger laterally with 8–11 accessory teeth. Palp with long setae medially on trochanter and femur (Fig. 3B). Number of setae in genital region highly variable (Fig. 4). Abdominal tergites I–X distinctly divided, tergite XI undivided; chaetotaxy of tergites I–X (left+right half-tergite): 5–6+5–7: 4–6+5–6: 4–6+5–6: 5–6+6: 6–7+6–7: 6–7+6–7: 6–7+6–7: 6–7+6–7: 5–8+5–7: 5–6+4–6, tergite XI with 8–9 setae, including a pair of long tactile setae.

Discussion

Megachernes pavlovskyi was originally described by Redikorzev (1949) from cracks in a livestock barn in Turkmenistan and from Tajikistan. His description contains basic morphological and morphometric characters, as well as figures of an entire specimen, the chelicera and coxa IV. Beier (1959) recorded several adults and nymphs taken from guano in a cave in Afghanistan, considering the species to be a troglophile. Only the setation of the male palpal femur

and the measurements of the palpal femur of one male and one female were given (Beier 1959). Schawaller (1986) recorded the species from Kyrgyzstan, based on about 40 specimens collected in bat and pigeon guano. Krumpál (1986) described the species *Megachernes caucasicus*, found in bat guano in a cave in Azerbaijan (Azykh Cave, Karabakh). Schawaller & Dashdamirov (1988) recorded more than 200 *Megachernes* specimens from bat guano at the type locality of *M. caucasicus* and, in addition, two specimens from a *Taxus-Buxus-Fagus* forest, western Caucasus, Russia (Krasnodar prov., Sochi/Khosta), having compared them with type material of *M. caucasicus*. As a result, *M. caucasicus* was found to be a junior synonym of *M. pavlovskyi*. Rich material from the Azykh Cave was later restudied and accompanied by new illustrations of the male palp and female coxa IV (Dashdamirov & Schawaller 1992). Profound variation in many characters was revealed, particularly the dimensions of the pedipalps and the number of accessory teeth on the chelal fingers. Moreover, the Caucasian specimens were very similar to material from Central Asia and Afghanistan (Beier 1959, Schawaller 1986, Dashdamirov & Schawaller 1995). More recently, Dashdamirov (2004) studied a small collection from northern Pakistan that fell within this range of variation and was therefore identified as *M. pavlovskyi*. It is concluded, that *M. pavlovskyi* is a highly widespread and vagile species, probably as a result of its periodic associations with bats and rodents (phoresis), and, perhaps, humans.

The main taxonomic characters of the Iranian females examined correspond to those given by Dashdamirov (2004). The material described here represents the first discovery of this genus in Iran. Because the country is vast and ecologically diverse, further material of this genus can be expected. Moreover, this is the first record of *M. pavlovskyi* from the nest of a porcupine.

Acknowledgements

The authors would like to thank to Alica Christophoryová for technical assistance with the figures, Anna Šestáková for help with dissection of the female genitalia and Martin Fris for the revision of the English text. Finally, we thank Prof. Sergei Golovatch (Moscow) for critical remarks, Yaser Bakhshi (Shiraz University, Iran) for help with collecting the material and Prof. Volker Mahnert and two anonymous reviewers for valuable comments on the manuscript.

References

Beier M 1948 Phoresie und Phagophilie bei Pseudoscorpionen. – Österreichische Zoologische Zeitschrift 1: 441-497

Beier M 1959 Zur Kenntnis der Pseudoscorpioniden-Fauna Afghanistans. – Zoologische Jahrbücher, Abteilung für Systematik, Ökologie und Geographie der Tiere 87: 257-282

Beier M 1963 Ordnung Pseudoscorpionidea (Afterskorpione). Bestimmungsbücher zur Bodenfauna Europas, 1. Akademie-Verlag. Berlin. 313 pp.

Dashdamirov S 2004 Pseudoscorpions from the mountains of northern Pakistan (Arachnida: Pseudoscorpiones). – Arthropoda Selecta 13: 225-261

Dashdamirov S & Schawaller W 1992 [Pseudoscorpions of the Caucasian fauna (Arachnida Pseudoscorpionida)]. – Arthropoda Selecta 1(4): 31-72 (in Russian)

Dashdamirov S & Schawaller W 1995 Pseudoscorpions from Middle Asia, part 4 (Arachnida: Pseudoscorpiones). – Stuttgarter Beiträge zur Naturkunde (A) 522: 1-24

Harvey MS 1991 Catalogue of the Pseudoscorpionida. Manchester University Press. Manchester and New York. 726 pp.

Harvey MS 1992 The phylogeny and classification of the Pseudoscorpionida (Chelicerata: Arachnida). – Invertebrate Taxonomy 6: 1373-1435 – doi: 10.1071/IT9921373

Harvey MS 2011 Pseudoscorpions of the world, version 2.0. – Internet: http://www.museum.wa.gov.au/catalogues/pseudoscorpions (5.6.2013)

Harvey MS, Ratnaweera PB, Udagama PVW & Wijesinghe MR 2012 A new species of the pseudoscorpion genus *Megachernes* (Pseudoscorpiones: Chernetidae) associated with a threatened Sri Lankan rainforest rodent, with a review of host associations of *Megachernes*. – Journal of Natural History 46: 2519-2535 – doi: 10.1080/00222933.2012.707251

Judson MLI 2007 A new and endangered species of the pseudoscorpion genus *Lagynochthonius* from a cave in Vietnam, with notes on chelal morphology and the composition of the Tyrannochthoniini (Arachnida, Chelonethi, Chthoniidae). – Zootaxa 1627: 53-68

Krumpál M 1986 Pseudoscorpione (Arachnida) aus Höhlen der UdSSR. Über Pseudoscorpioniden-Fauna der UdSSR V. – Biología 41: 163-172

Lindberg K 1961 Recherches biospéléologiques en Afghanistan. – Acta Universitatis Lundensis, nova series 57: 1-39

Redikorzev V 1949 [Pseudoscorpions of Central Asia]. – Travaux de l'Institute Zoologique de l'Académie des Sciences de l'URSS 8(4): 638-668 (in Russian)

Schawaller W 1986 Pseudoskorpione aus der Sowjetunion, Teil 2 (Arachnida: Pseudoscorpiones). – Stuttgarter Beiträge zur Naturkunde (A) 396: 1-15

Schawaller W & Dashdamirov S 1988 Pseudoskorpione aus dem Kaukasus, Teil 2 (Arachnida). – Stuttgarter Beiträge zur Naturkunde (A) 415: 1-51

Spiders (Araneae) from Albania and Kosovo in the collection of Carl Friedrich Roewer

Blerina Vrenozi & Peter Jäger

doi: 10.5431/aramit4604

Abstract. The spider collection (Arachnida: Araneae) from Albania and Kosovo in the Senckenberg Research Institute, Frankfurt am Main is reviewed. A total of 122 adult specimens were found belonging to 73 species. Records of 48 species for Albania and 28 species for Kosovo, 20 of them new to Kosovo, are presented. Furthermore there are seven new country records for Albania: *Platnickina nigropunctata*, *Erigone remota*, *Tenuiphantes tenebricola*, *Pardosa agrestis*, *Callobius claustrarius* and *Zelotes femellus*. Additionally, *Pardosa cavannae* is the first record for the Balkan Peninsula. So far 381 species are known for Albania. A total of 106 species is known from Kosovo now; a list of the 86 spider species formerly known to Kosovo is included.

Keywords: Balkan fauna, checklist, new records

The Arachnida collection in the Senckenberg Research Institute, Frankfurt, Germany, dates from 1833 when the spider collection of Karl Friedrich Wider was donated to the Senckenberg Natural History Museum (Kraus 2006). Since then Carl Koch, Philipp Bertkau, Wilhelm Dönitz, Wilhelm Bösenberg, Embrik Strand, Ludwig Koch, Friedrich Dahl and other arachnologists deposited material in the Senckenberg collection. However, the main contribution to this collection was made by Carl Friedrich Roewer and Hermann Wiehle. Today the arachnological collection is one of the most important in the world, and includes more than 77,000 series identified to species level including about 12,000 type series.

Spiders from Albania and Kosovo (previously part of Yugoslavia resp. Serbia) are included in the collection of Carl Friedrich Roewer. Formerly, there was no differentiation between these two countries due to historical and political reasons. Therefore all material labelled as from Albania was examined. This collection includes significant data of spiders collected in northeast and southeast Albania, which were partly published by Deltshev et al. (2011) and therefore raised the interest of the first author. New country records not published before were of great importance for starting this investigation. This present paper contributes to the checklist of Albanian spiders. Additionally, some records for Kosovo based on the Roewer collection and from a critical review of Deltshev et al. (2003) are given. The present paper complements an on-going series of papers on Albanian spiders (Vrenozi & Haxhiu 2008, Deltshev et al. 2011, Vrenozi 2012, Vrenozi & Jäger 2012, Vrenozi & Dunlop 2013).

Blerina VRENOZI, Faculty of Natural Sciences, Boulevard "Zogu I", Tirana, Albania, blerina.vrenozi@fshn.edu.al
Peter JÄGER, Arachnology, Senckenberg Research Institute, Senckenberganlage 25, 60325 Frankfurt am Main, Germany, peter.jaeger@senckenberg.de

submitted 16.12.11, accepted 24.9.13, online 4.10.13

Methods

The material presented here derives from the collection of Carl Friedrich Roewer, which is deposited in the Senckenberg Research Institute in Frankfurt am Main (SMF). It was collected between 1917 and 1961 in the north-eastern and south-eastern areas of Albania and in Kosovo (Fig. 1). In some cases, data for several specimens taken from the SMF card files lacked the year of collection and who identified it. All specimens in the Roewer collection were reviewed at the end of 2010.

Furthermore, localities in Kosovo mentioned in Deltshev et al. (2003) in the Serbian language are revised and Albanian names as well as geographical coordinates are given.

The main literature used for identification was Grimm (1985), Heimer & Nentwig (1991), Metzner (1999), Nentwig et al. (2013) and Roberts (1987, 1995). Nomenclature and order of families in the species lists follows Platnick (2013). The data concerning the general distribution are taken from Platnick (2013) and Helsdingen (2012).

Data on elevation, latitude and longitude are taken from http://wikimapia.org, http://en.wikipedia.org and https://maps.google.com.

Fig. 1: Map of Albania and Kosovo with the county capitals treated in this paper.

Abbreviations

det. – determinavit (Latin for "he/she has identified")
ex RII – previous RII vial is separated into two series, one keeps the old RII number, the other (present) gets a new SMF number
leg. – legit (Latin for "he/she has collected")
rev. – revidit (Latin for "he/she has reviewed", here: changed previous identification)
RII – second (larger) part of the Roewer collection [e.g., SMF 9900828 is the collection number for RII 828]
SMF – Senckenberg Research Institute, Frankfurt
vid. – vidit (Latin for "he/she has seen, examined"; here: confirmed previous identification)

Localities [with explanations in brackets]

Albania

Galica Luma, Galica Lumus, Galica Lums [Mt. Gjallica e Lumës, mountain in Kukës], 2489 m a.s.l., N 42°1'34", E 20°28'12".

Kösztil, Koestil [Gostil, village in Kukës], 317 m a.s.l., N 42°3'8", E 20°25'13".

Korab [Mt. Korab, mountain in Dibër], 2756 m a.s.l., N 41°48'41", E 20°33'55".

Kula Lums, Kula Lumps [Kulla e Lumës, village in Kukës], 509 m a.s.l., N 42°4'15", E 20°26'47".

Mt. Koprionte [Mt. Koritnik, mountain in Kukës], 2393 m a.s.l., N 42°5'5", E 20°32'22".

Sandschak korita, Korita [Koritë, village in Korçë], 1178 m a.s.l., N 40°46'55", E 20°48'52".

Kosovo

Banjska [Banjskë, village near Mitrovicë], 200 m a.s.l., N 42°51'29", E 20°57'14".

Bjelopolje [Bellopojë, village in Pejë], 754 m a.s.l., N 42°46'26", E 20°33'54".

Gazimestan [Memorial Park near Prishtinë], 585 m a.s.l., N 42°41'19", E 21°07'42".

Gnjilane [Gjilan, town], 1000 m a.s.l., N 42°28'45", E 21°27'55".

Kačanik [Kaçanik, town], 678 m a.s.l., N 42°14'12", E 21°15'19".

Kosovska Mitrovica [Mitrovicë, town], 688 m a.s.l., N 42°53'31", E 20°52'12".

Lebane [Lebanë, municipality near Prishtinë], 275 m a.s.l., N 42°44'29", E 21°08'41".

Ljubičevo [Lubiqevë, village near Prizren], 2000 m a.s.l., N 42°09'22", E 20°43'57".

Monastery Visoki Dečani [Monastery near the town of Deçan], 661 m a.s.l., N 42°32'48", E 20°16'14".
Mt. Kopaonik [mountain in the northern part of Kosovo], 1789 m a.s.l., N 43°10'16", E 20°55'44".
Mt. Koprivnik [mountain near Pejë], 2460 m a.s.l., N 42°37'32", E 20°12'28".
Crni Kamen, Mt. Šar-Planina [village in Mt. Sharr, mountain in the southern part of Kosovo], 2550 m a.s.l., N 42°08'50", E 20°48'49".
Mt. Žljeb, Mons Zljeb [Mt. Zhleb, mountain near Pejë], 2365 m a.s.l., N 42°75'5", E 20°24'53".
Nerodimlje [Nerodime, area near Ferizaj], 345 m a.s.l., N 42°21'49", E 21°05'57".
Peć, Pek, Ipek [Pejë, town], 505 m a.s.l., N 42°39'39", E 20°18'37".
Plavenica [Plav, municipality near Prizren], 2000 m a.s.l., N 42°07'05", E 20°39'54".
Radavac, source of the Beli Drim River [Radavci, village near the source of Drini i Bardhë near Pejë], 2000 m a.s.l., N 42°44'20", E 20°19'18".
Sazlija [Sazli, village near Ferizaj], 571 m a.s.l., N 42°24'27", E 21°11'00".
Sredska [Sredskë, municipality near Prizren], 864 m a.s.l., N 42°10'20", E 20°51'18".
Zvečan [Zveçan, municipality near Mitrovicë], 712 m a.s.l., N 42°58'17", E 20°48'04".

Results

In total, 126 specimens of spiders including 98 females, 24 males and four juveniles were examined, comprising 73 species from 52 genera and 18 families, from which 48 species from 38 genera and 15 families were from Albania (Tab. 1). One female of *Nomisia* sp. could not be identified to species level until more specimens, including males and females, are found. Seven new records presented in this paper were found in north-eastern areas of Albania (marked with * in Tab. 1):

Platnickina nigropunctata has a Mediterranean distribution, known so far from Greece, Italy and the western Mediterranean. This record extends the known distribution range to the Balkan Peninsula. In Albania one male was recorded.

Erigone remota is a typical high mountain species with a Palaearctic distribution. This species is known in the Balkan Peninsula only from Macedonia and Romania. One female was collected by Roewer on 19.10.1917, in the Mt. Gjallica e Lumës.

Tenuiphantes tenebricola is widely spread in the Palaearctic region. This record extends our knowledge about its distribution in the Balkan Peninsula, where it was known before in every surrounding country, except Macedonia and Greece. In Albania one male was recorded.

Pardosa agrestis is widely spread in the Palaearctic region. The present record fills a gap extending its distribution range into Albania, as it was previously known from all surrounding countries except Bosnia and Herzegovina. Seven females were recorded in Albania.

Pardosa cavannae was known before only in the National Park of Majella, Province of L'Aquila in Italy. This record is the first find for the Balkan Peninsula, the identification of which was confirmed by C. Deltshev. Following Tongiorgi (1966), this species is known from the high mountains. One female was recorded in Albania, identified by Wunderlich in 2008.

Callobius claustrarius has a Palaearctic distribution, except the United Kingdom, Iberian Peninsula, Scandinavia, and the Far East where is found only in the Asian parts of Russia. In the Balkan Peninsula *C. claustrarius* is known from Macedonia, Greece, Bulgaria and Romania. Two females were collected in 1928 in the Mt. Gjallica e Lumës.

Zelotes femellus is distributed in southern Europe, where it is known from Spain, Corsica (France), Italy and Ukraine. In the Balkan Peninsula it is found in Croatia, Greece and Romania. One subadult male and one female were collected in 1927 in the Kulla e Lumës, which were confirmed by C. Deltshev.

Records of 28 species from 20 genera and nine families were collected in Kosovo (Tab. 1). Twenty species are recorded for Kosovo for the first time

Tab. 1: List of the spider species and specimens of Roewer's collection from Albania and Kosovo. * = first record for Albania, ** = first record for Kosovo.

Family/Species	Material examined
Pholcidae	
Holocnemus pluchei (Scopoli, 1763)	1♀, Albania, Kulla e Lumës, Akad. Balkan Expedition 1918, Kraus det., Vrenozi & Jäger vid. (RII 3726)

Family/Species	Material examined
Segestriidae	
Segestria senoculata (Linnaeus, 1758)	1♂, Albania, Mt. Korab, Roewer det. 1927, Vrenozi & Jäger vid. (RII 667)
Dysderidae	
***Dysdera longirostris* Doblika, 1853	1♀, Kosovo, Mt. Zhleb, leg. 1927, Vrenozi & Blick vid. (RII 669)
Theridiidae	
Asagena phalerata (Panzer, 1801)	1♀, 1 subadult ♀, Albania, Gostil, leg. 1935, Vrenozi & Jäger vid. (RII 1870)
Enoplognatha ovata (Linnaeus, 1758)	1♀, Albania, Kulla e Lumës, leg. 1935, Vrenozi & Jäger vid. (RII 1895)
Enoplognatha latimana Hippa & Oksala, 1982	2♀, Albania, Kulla e Lumës, leg. 1935, sub *Theridion ovatum* (Clerck, 1757), Vrenozi & Jäger rev. (ex RII 1895; SMF 61110)
Heterotheridion nigrovariegatum (Simon, 1873)	1♂, Albania, Wunderlich det. 1980, Vrenozi & Jäger vid. (RII 11619)
Kochiura aulica (C.L. Koch, 1838)	1♀, Albania, sub *Theridion aulicum* C.L. Koch, 1838, Vrenozi & Jäger vid. (RII 6153)
Pholcomma gibbum (Westring, 1851)	2♂, 2♀, Albania, Koritë, leg. 1935, Vrenozi & Jäger vid. (RII 1863)
**Platnickina nigropunctata* (Lucas, 1846)	1♂, Albania, Wunderlich det., Vrenozi & Blick vid. (ex RII 11615; SMF 37631)
Robertus frivaldszkyi (Chyzer, 1894)	1♀, Albania, Deltshev det. 10.2007 (ex RII 6302; SMF 57437)
Steatoda paykulliana (Westring, 1851)	2♀, Albania, Mt. Korab, leg. 1935, sub *Teutana grossa* (C.L. Koch, 1838), Jäger & Vrenozi rev. (RII 1844)
***Theridion pictum* (Walckenaer, 1802)	1♀, Kosovo, Pejë, leg. 1935, sub *Theridion impressum* L. Koch, 1881, Vrenozi & Jäger rev. (RII 1889)
Theridion varians Hahn, 1833	1♂, Albania, Wunderlich det., Vrenozi & Jäger vid. (ex RII 11615; SMF 37623)
Linyphiidae	
Erigone dentipalpis (Wider, 1834)	1♀, Albania, Wunderlich det. 1968, Vrenozi & Jäger vid. (RII 11896)
**Erigone remota* L. Koch, 1869	1♀, Albania, Mt. Gjallica e Lumës, Roewer leg. 19.10.1917, Wunderlich det. 1968, Vrenozi & Jäger vid. (ex RII 11859; SMF 24729)
Linyphia triangularis (Clerck, 1757)	1♂, Albania, van Helsdingen det. 1965, Vrenozi & Jäger vid. (ex RII 12310; SMF 24671)
Meioneta rurestris (C.L. Koch, 1836)	1♀, Albania, Wunderlich det. 1968, Vrenozi & Jäger vid. (ex RII 6151; SMF 22933)
Oedothorax apicatus (Blackwall, 1850)	1♀, Albania, Wunderlich det. 1968, Vrenozi & Jäger vid. (ex RII 6151; SMF 22932)
**Tenuiphantes tenebricola* (Wider, 1834)	1♂, Albania, Wunderlich det. 1968, Vrenozi & Jäger vid. (ex RII 11896; SMF 22926)
Tetragnathidae	
***Metellina merianae* (Scopoli, 1763)	2♂, 1♀, Kosovo, Plav, leg. 1927, sub *Meta merianae* (Scopoli, 1763), Vrenozi & Jäger vid. (RII 820)
Araneidae	
***Aculepeira ceropegia* (Walckenaer, 1802)	1♀, Kosovo, Pejë, leg. 1927, Levi rev. 1976, Vrenozi & Jäger vid. (RII 833).
***Araneus angulatus* Clerck, 1757	3♀, Kosovo, Pejë, leg. 1935, sub *Araneus grossus* (C.L. Koch, 1844), Vrenozi & Jäger rev. (RII 869)
***Araneus circe* (Audouin, 1826)	1♀, Kosovo, Pejë, leg. 1930, Vrenozi & Jäger vid. (RII 870)
Araniella cucurbitina (Clerck, 1757)	2♀, Albania, Mt. Gjallica e Lumës, Blanke det. 1977, Vrenozi & Jäger vid. (RII 1747); 1♀, Kosovo, Pejë, Blanke det. 1977. Vrenozi & Jäger vid. (RII 865)

Family/Species	Material examined
**Araniella opisthographa* (Kulczyński, 1905)	1♂, 1♀, Albania, Mt. Gjallica e Lumës, Roewer leg. 1930, sub *Araneus cucurbitinus* Clerck, 1757, Blanke rev. 1977, Vrenozi & Jäger rev. (SMF 29578); 3♀, Kosovo, Pejë, Blanke rev. 1977, sub *Araneus cucurbitinus* Clerck, 1757, Vrenozi & Jäger rev. (SMF 29590)
Neoscona adianta (Walckenaer, 1802)	1♀, Albania, Kulla e Lumës, Roewer leg. 1927, Vrenozi & Jäger vid. (ex RII 828; SMF 9900828)
Lycosidae	
**Alopecosa aculeata* (Clerck, 1757)	1♀, Kosovo, Pejë, Roewer leg. 7.1917, det. 1954, Vrenozi & Jäger vid. (RII 2209)
Alopecosa cursor (Hahn, 1831)	2♀, Albania, Roewer det. 1954, Vrenozi & Jäger vid. (RII 2231)
Alopecosa pulverulenta (Clerck, 1757)	2♀, Albania, Mt. Korab, Roewer det. 1954, Vrenozi & Jäger vid. (RII 2212)
**Pardosa agrestis* (Westring, 1861)	7♀, Albania, Roewer det. 1954, sub *Pardosa blanda* (C.L. Koch, 1833), Jäger & Vrenozi rev. (RII 3921)
***Pardosa alacris* (C.L. Koch, 1833)	1♂, Kosovo, Pejë, Wunderlich rev. 1984, sub *Pardosa pseudolugubris* Wunderlich, 1984, Vrenozi & Blick vid. (RII 11896)
***Pardosa amentata* (Clerck, 1757)	2♀, Kosovo, Mt. Koprivnik, Roewer det. 1954, Vrenozi & Jäger vid. (RII 2264)
**Pardosa cavannae* Simon, 1881	1♀, Albania, Wunderlich det. 2008, Vrenozi & Jäger vid. (SMF 60982). It is not known, if the specimen is part of the Roewer collection or not, but it is included in the manuscript because it is from Albania.
***Pardosa prativaga* (L. Koch, 1870)	1♀, Kosovo, Pejë, Roewer det. 1954, sub *Pardosa kervillei* Simon, 1937, Vrenozi & Blick rev. (RII 3923)
Oxyopidae	
Oxyopes lineatus Latreille, 1806	1♂, 4♀, Albania, Kulla e Lumës, leg. 06.07.1918, Wunderlich det. 1980, Vrenozi & Jäger vid. (ex RII 4056; SMF 30585)
Zoridae	
Zora spinimana (Sundevall, 1833)	2♀, Albania, Kulla e Lumës, leg. 1930, Vrenozi & Jäger vid. (RII 2409)
Agelenidae	
Agelena labyrinthica (Clerck, 1757)	1♂, Albania, Kulla e Lumës, leg. 1935, Vrenozi & Jäger vid. (RII 6145)
Inermocoelotes inermis (L. Koch, 1855)	1♀, Kosovo, Pejë, leg. 1929, sub *Coelotes terrestris* (Wider, 1834), Vrenozi & Blick rev. (RII 1273)
***Lycosoides coarctata* (Dufour, 1831)	1♀, Kosovo, Mt. Zhleb, leg. 1934, Vrenozi & Blick vid. (RII 5436)
Amaurobiidae	
**Callobius claustrarius* (Hahn, 1833)	2♀, Albania, Mt. Gjallica e Lumës, leg. 1928, Vrenozi & Jäger vid. (RII 961)
Titanoecidae	
Nurscia albomaculata (Lucas, 1846)	1♀, Albania, Deltshev det. 10.2007 (ex RII 6302; SMF 57441)
Clubionidae	
***Clubiona stagnatilis* Kulczyński, 1897	1♀, Kosovo, Pejë, leg. 1961, sub *Clubiona pallidula* (Clerck, 1757), Vrenozi & Blick rev. (RII 13872)
Gnaphosidae	
***Berlandina plumalis* (O. Pickard-Cambridge, 1872)	1♀, Kosovo, Pejë, leg. 1961, Jäger & Vrenozi vid. (RII 13875)
Callilepis nocturna (Linnaeus, 1758)	1♀, Albania, Deltshev det. 10.2007 (ex RII 6302; SMF 57419)
Drassodes lapidosus (Walckenaer, 1802)	1♀, Albania, Mt. Korab, leg. 1927, Vrenozi & Jäger vid. (RII 565)
Drassodes lutescens (C.L. Koch, 1839)	1♂, Albania, Kulla e Lumës, leg. 1927, Vrenozi & Blick vid. (RII 574)
Nomisia sp.	1♀, Albania, Kulla e Lumës, Grimm det. 1982, Vrenozi & Blick vid. (RII 6147)

Family/Species	Material examined
Trachyzelotes pedestris (C.L. Koch, 1837)	1♀, Albania, Mt. Korab, leg. 1931, Vrenozi & Jäger vid. (RII 2432)
Zelotes apricorum (L. Koch, 1876)	1♀, Albania, Kulla e Lumës, leg. 1931, sub *Zelotes oblongus* (C.L. Koch), Grimm rev. 1982, Vrenozi & Jäger vid. (RII 2438)
**Zelotes femellus* (L. Koch, 1866)	1 subadult ♂, 1♀, Albania, Kulla e Lumës, leg. 1927, Vrenozi & Jäger vid. (RII 589)
Philodromidae	
Philodromus cespitum (Walckenaer, 1802)	1♀, Albania, Mt. Gjallica e Lumës, leg. 16.7.1918, sub *Xysticus ninnii* Thorell, 1872, Loerbroks rev. sub *Philodromus* sp., Vrenozi & Jäger rev. (RII 1661)
Thanatus atratus Simon, 1875	1♀, Albania, Kulla e Lumës, Roewer leg. 06.07.1918, Wunderlich det. 1980, sub *Thanatus* sp., Vrenozi & Jäger rev. (ex RII 4056; SMF 30583)
Thomisidae	
Cozyptila blackwalli (Simon, 1875)	1♀, Albania, Kulla e Lumës, leg. 1929, Vrenozi & Jäger vid. (RII 1680)
Synema globosum (Fabricius, 1775)	1♀, Albania, Kulla e Lumës, leg. 1928, sub *Synema plorator* (C.L. Koch, 1837), Loerbroks rev. 1980, Vrenozi & Jäger vid. (RII 930); 3♀; Kosovo, Pejë. leg. 1928, Vrenozi & Jäger vid. (RII 929)
Thomisus onustus Walckenaer, 1806	2♀, 1 subadult ♀, Kosovo, Pejë, leg. 1929, Vrenozi & Jäger vid. (RII 936)
***Tmarus piger* (Walckenaer, 1802)	1♀, 1 subadult ♀, Kosovo, Pejë, leg. 1929, Vrenozi & Jäger vid. (RII 1640)
Xysticus acerbus Thorell, 1872	1♀, Albania, Kulla e Lumës, leg. 1929, sub *Xysticus kempelenii* Thorell, 1872, Jantscher rev. 11.1999, Vrenozi & Jäger vid. (ex RII 1656; SMF 9901656)
***Xysticus audax* (Schrank, 1803)	1♀, Kosovo, Pejë, leg. 1929, Vrenozi & Jäger vid. (RII 1650)
***Xysticus cristatus* (Clerck, 1757)	1♀, Kosovo, Pejë, leg. 1929, sub *Xysticus audax* (Schrank, 1803), Vrenozi & Jäger rev. (RII 1650)
Xysticus kochi Thorell, 1872	1♀, Kosovo, Pejë, leg. 1929, Jantscher rev. 11.1999, Vrenozi & Jäger vid. (RII 1643)
Xysticus graecus C.L. Koch, 1838	1♀, Albania, Gostil, leg. 1929, sub *Xysticus striatipes* L. Koch, 1870, Vrenozi & Deltshev rev. (RII 1663)
Salticidae	
Evarcha falcata (Clerck, 1757)	5♂, 2♀, Albania, Kulla e Lumës, leg. 1930, sub *Evarcha blancardi* (Scopoli 1763), Vrenozi & Jäger vid. (ex RII 2075; SMF 9902075)
***Heliophanus auratus* C.L. Koch, 1835	2♀, Kosovo, Pejë, Roewer leg. 6.1921, Logunov det. 2005, Vrenozi & Jäger vid. (ex RII 1993; SMF 9901993); 1♀, Kosovo, Pejë, Logunov det. 2005, Vrenozi & Jäger vid. (ex RII 1995; SMF 9901995)
Heliophanus cupreus (Walckenaer, 1802)	2♀, Kosovo, Pejë, leg. 1930, Vrenozi & Jäger vid. (RII 1978)
Heliophanus flavipes (Hahn, 1832)	2♂, Kosovo, Pejë, leg. 1930, sub *Heliophanus ritteri* (Scopoli, 1763), Vrenozi & Jäger vid. (RII 1982); 1♀, Kosovo, Pejë, Logunov det. 2005, Vrenozi & Jäger vid. (ex RII 1995; SMF 40467)
Heliophanus lineiventris Simon, 1868	1♀, Albania, Mt. Korab, Logunov det. 2005, Vrenozi & Jäger vid. (ex RII 1987; SMF 57337)
Heliophanus simplex Simon, 1868	1♀, Albania, Kulla e Lumës, Logunov det. 2005, Vrenozi & Jäger vid. (ex RII 1994; SMF 57318)
Mendoza canestrinii (Ninni, 1868)	2♀, Albania, Mt. Koritnik, leg. 7.1922, Vrenozi & Jäger vid. (RII 2026)
Philaeus chrysops (Poda, 1761)	2♀, Albania, Koritë, leg. 1930, Vrenozi & Jäger vid. (RII 2049)
***Phlegra fasciata* (Hahn, 1826)	1♀, Kosovo, Bellopojë, leg. 1930, Vrenozi & Jäger vid. (RII 2056)
Sitticus pubescens (Fabricius, 1775)	1♀, Kosovo, Pejë, leg. 1930, Vrenozi & Jäger vid. (RII 2011)
***Synageles dalmaticus* (Keyserling, 1863)	2♂, 1♀, Kosovo, Bellopojë, leg. 1930, Vrenozi & Jäger vid. (RII 1999)

(marked with ** in Tab. 1). Almost all these species are found in the adjacent countries of Kosovo (Nikolić & Polenec 1981, Nentwig et al. 2013; and several papers on Albanian spiders such as Vrenozi & Haxhiu 2008, Deltshev et al. 2011, Vrenozi 2012, Vrenozi & Jäger 2012), except for the two species *Lycosoides coarctata* and *Synageles dalmaticus,* which are recorded only from Macedonia. *Berlandina plumalis* with a distribution from West Africa to Central Asia (Platnick 2013) is the first record for the region and the second record for the Balkan Peninsula after Greece (Nentwig et al. 2013).

The revised paper of Deltshev et al. (2003) documented 86 species from Kosovo. Spiders are cited by different authors, mostly for Mt. Kopaunik in the northern part of Kosovo (40 species), followed by the areas of Pejë and Prizren districts in the north-western and western part, near the Albanian borders (respectively 20 and 23 species), and Prishtinë in the eastern part of Kosovo (22 species); meanwhile Nerodime, the Monastery of Deçan, Mitrovicë, Crni Kamen (Mt. Sharr) and Kaçanik, are the less cited municipalities and districts. Almost 50% of all spiders known from Kosovo were mentioned by Stojićević (1929) and Drensky (1936) (Tab. 2).

Discussion

Previously, 374 spider species were known for Albania (Deltshev et al. 2011: 335 species, Vrenozi 2012: 6 species, Vrenozi & Jäger 2012: 32 species, Vrenozi & Dunlop 2013: 1 species). The Roewer collection offers seven new records for the Albanian spider fauna; thus 381 species are now known for this country.

According to Nikolić & Polenec (1981), only three species were known for Kosovo before: *Robertus arundineti* (O. P.-Cambridge, 1871), *Styloctetor stativus* (Simon, 1881) (sub *Anacotyle stativa*) and *Trichoncus affinis* Kulczyński, 1894. Deltshev et al. (2003) mentioned 86 species for Kosovo which were known for the districts of Deçan, Ferizaj, Gjilan, Kaçanik, Mitrovicë, Pejë, Prishtinë, Prizren, Mt. Kopaonik and Mt. Sharr. From these, 25 spider species are known only from Mt. Kopaonik, without a precise locality. Nevertheless this mountain is part of both Kosovo and Serbia, these species are thus considered as records for Kosovo and Serbia at the same time. The present review of the Roewer collection has resulted in 28 records, with eight species known before for Kosovo: *Araniella cucurbitina* (Clerck, 1757), *Inermocoelotes inermis* (L. Koch, 1855), *Synema globosum* (Fabricius, 1775), *Thomisus onustus* Walckenaer, 1806, *Xysticus kochi* Thorell, 1872, *Heliophanus cupreus* (Walckenaer, 1802), *Heliophanus flavipes* (Hahn, 1832) and *Sitticus pubescens* (Fabricius, 1775). The 20 other records are new to Kosovo. All species were recorded in the north-western and western areas, near the Albanian border. These species increase the number of spider species known so far from Kosovo to 106.

Acknowledgements

We thank Theo Blick from the Senckenberg Research Institute in Frankfurt/M. for his assistance during the revision of some species; Dr. Barbara Knoflach-Thaler and Dr. Robert Bosmans for providing literature; Prof. Dr. Perikli Qiriazi, Prof. Dr. Aleko Miho and Prof. Dr. Lulzim Shuka of the Tirana University for checking some old names of the geographic areas. B.V. kindly acknowledges the Sencken-

Tab. 2: List of the spider species from Kosovo according to Deltshev et al. (2003).

Nr.	Family/Species	Locality (References)
	Atypidae	
1	*Atypus piceus* (Sulzer, 1776)	Prizren (Stojićević 1929)
	Dysderidae	
2	*Dasumia kusceri* (Kratochvíl, 1935)	Crni Kamen, Mt. Sharr (Nikolić & Polenec 1981)
	Theridiidae	
3	*Asagena phalerata* (Panzer, 1801)	Sazli (Stojićević 1929), . Zhljeb (Knoflach 1996)
4	*Crustulina guttata* (Wider, 1834)	Sazli (Stojićević 1929)
5	*Enoplognatha ovata* (Clerck, 1757)	Lubiqevë (Bresjančeva 1907, Drensky 1936)
6	*Phylloneta sisyphia* (Clerck, 1757)	Lubiqevë (Bresjančeva 1907, Drensky 1936)
7	*Robertus arundineti* (O. P.-Cambridge, 1871)	Nerodime (Stojićević 1929), Kosovo (Drensky 1936, Nikolić & Polenec 1981)
8	*Steatoda bipunctata* (Linnaeus, 1758)	Mt. Kopaonik (Drensky 1936)
9	*Steatoda castanea* (Clerck, 1757)	Mt. Kopaonik (Drensky 1936)

Nr.	Family/Species	Locality (References)
	Linyphiidae	
10	*Agyneta fuscipalpa* (C.L. Koch, 1836)	Sazli (Stojićević, 1929)
11	*Bathyphantes approximatus* (O. P.-Cambridge, 1871)	Mt. Kopaonik (Nikolić & Polenec 1981)
12	*Erigone atra* Blackwall, 1833	Mt. Kopaonik (Stojićević 1929)
13	*Erigone dentipalpis* (Wider, 1834)	Sazli (Stojićević 1929)
14	*Fageiella ensigera* Deeleman-Reinhold, 1974	Radavci, source of the River Drini i Bardhë (Deeleman-Reinhold 1974)
15	*Mansuphantes mansuetus* (Thorell, 1875)	Mt. Kopaonik (Stojićević 1929, Drensky 1936, Nikolić & Polenec 1981)
16	*Macrargus rufus* (Wider, 1834)	Mt. Kopaonik (Nikolić & Polenec 1981)
17	*Oedothorax gibbosus* (Blackwall, 1841)	Gjilan (Stojićević 1929, Drensky 1936)
18	*Pallidiphantes trnovensis* (Drensky, 1931)	Karamakis Cave, Pejë (Deeleman-Reinhold 1985, Deltshev et al. 1996)
19	*Porrhomma pygmaeum* (Blackwall, 1834)	Sazli (Stojićević 1929, Drensky 1936)
20	*Styloctetor stativus* (Simon, 1881)	Sazli (Stojićević 1929, Nikolić & Polenec 1981), Kosovo (Nikolić & Polenec 1981)
21	*Trichoncus affinis* Kulczyński, 1894	Sazli (Stojićević 1929), Kosovo (Nikolić & Polenec 1981)
	Tetragnathidae	
22	*Metellina segmentata* (Clerck, 1757)	Banjskë (Kolosváry 1940)
23	*Tetragnatha extensa* (Linnaeus, 1758)	Gjilan (Stojićević 1929)
	Araneidae	
24	*Agalenatea redii* (Scopoli, 1763)	Mitrovicë (Kolosváry 1938, 1940)
25	*Araneus diadematus* Clerck, 1757	Mt. Kopaonik (Drensky 1936)
26	*Araniella alpica* (L. Koch, 1869)	Mt. Kopaonik (Stojićević 1929, Drensky 1936)
27	*Araniella cucurbitina* (Clerck, 1757)	Lubiqevë (Bresjančeva 1907, Drensky 1936), Nerodime (Stojićević 1929), Mt. Kopaonik (Drensky 1936)
28	*Cyclosa conica* (Pallas, 1772)	Zveçan (Stojićević 1929)
29	*Gibbaranea gibbosa* (Walckenaer, 1802)	Mt. Kopaonik (Stojićević 1929, Drensky 1936)
30	*Gibbaranea omoeda* (Thorell, 1870)	Mt. Kopaonik (Nikolić & Polenec 1981)
31	*Hypsosinga albovittata* (Westring, 1851)	Sazli (Stojićević 1929)
32	*Hypsosinga pygmaea* (Sundevall, 1831)	Gjilan (Stojićević 1929)
33	*Hypsosinga sanguinea* (C.L. Koch, 1844)	Sazli (Stojićević 1929)
34	*Mangora acalypha* (Walckenaer, 1802)	Gjilan, Nerodime (Stojićević 1929)
35	*Singa hamata* (Clerck, 1757)	Lubiqevë (Bresjančeva 1907, Drensky 1936), Nerodime (Stojićević 1929)
36	*Zygiella keyserlingi* (Ausserer, 1871)	Pejë (Kolosváry 1938, 1940)
	Lycosidae	
37	*Alopecosa trabalis* (Clerck, 1757)	Lebanë, Sredskë (Stojićević 1929)
38	*Arctosa cinerea* (Fabricius, 1777)	Gjilan (Stojićević 1929)
39	*Arctosa leopardus* (Sundevall, 1833)	Sazli (Stojićević 1929)
40	*Hogna radiata* (Latreille, 1817)	Pejë (Kolosváry 1938)
41	*Pardosa agrestis* (Westring, 1861)	Sazli (Stojićević 1929), Gjilan (Drensky 1936)
42	*Pardosa agricola* (Thorell, 1856)	Mt. Kopaonik (Stojićević 1929, Drensky 1936)
43	*Pardosa albatula* (Roewer, 1951)	Mt. Kopaonik (Drensky 1936)
44	*Pardosa ferruginea* (L. Koch, 1870)	Mt. Kopaonik (Stojićević 1929, Drensky 1936)
45	*Pardosa hortensis* (Thorell, 1872)	Nerodime (Stojićević 1929), Gjilan (Drensky 1936)
46	*Pardosa morosa* (L. Koch, 1870)	Monastery in the town of Deçan (Kolosváry 1938, 1940)
47	*Pardosa paludicola* (Clerck, 1757)	Sazli (Stojićević 1929)
48	*Pardosa palustris* (Linnaeus, 1758)	Mt. Kopaonik (Stojićević 1929, Drensky 1936)
49	*Pardosa pullata* (Clerck, 1757)	Gjilan (Stojićević 1929)
50	*Pirata piscatorius* (Clerck, 1757)	Gjilan (Stojićević 1929)
51	*Piratula hygrophila* (Thorell, 1872)	Mt. Kopaonik (Nikolić & Polenec 1981)

Nr.	Family/Species	Locality (References)
52	*Trochosa ruricola* (De Geer, 1778)	Mt. Kopaonik (Drensky 1936)
53	*Xerolycosa miniata* (C.L. Koch, 1834)	Gazimestan, Prishtinë (Stojićević 1929)
54	*Xerolycosa nemoralis* (Westring, 1861)	Mt. Kopaonik, Gjilan (Drensky 1936)
	Pisauridae	
55	*Pisaura mirabilis* (Clerck, 1757)	Lubiqevë (Bresjančeva 1907, Drensky 1936), Nerodime, Sazli (Stojićević 1929), Monastery in the town of Deçan (Kolosváry 1938, 1940)
	Oxyopidae	
56	*Oxyopes ramosus* (Martini & Goeze, 1778)	Lubiqevë (Bresjančeva 1907, Drensky 1936)
	Agelenidae	
57	*Inermocoelotes falciger* (Kulczyński, 1897)	Pejë (Kolosváry 1938)
58	*Inermocoelotes inermis* (L. Koch, 1855)	Pejë (Kolosváry 1938, 1940), Mt. Koprivnik (Kolosváry 1940)
	Dictynidae	
59	*Emblyna brevidens* (Kulczyński, 1897)	Mt. Kopaonik (Nikolić & Polenec 1981)
	Miturgidae	
60	*Cheiracanthium elegans* Thorell, 1875	Prizren (Stojićević 1929)
	Liocranidae	
61	*Sagana rutilans* Thorell, 1875	Pejë (Kolosváry 1938), Koprivnik (Kolosváry 1940)
	Zodariidae	
62	*Zodarion aculeatum* Chyzer, 1897	Mt. Kopaonik (Drensky 1936)
	Gnaphosidae	
63	*Drassodes lapidosus* (Walckenaer, 1802)	Mt. Kopaonik (Stojićević 1929, Drensky 1936)
64	*Haplodrassus signifer* (C.L. Koch, 1839)	Mt. Kopaonik (Drensky 1936)
65	*Micaria pulicaria* (Sundevall, 1831)	Monastery in the town of Deçan (Kolosváry 1938, 1940)
66	*Scotophaeus blackwalli* (Thorell, 1871)	Gazimestan, Prishtinë (Stojićević 1929)
67	*Zelotes longipes* (L. Koch, 1866)	Zveçan (Stojićević 1929), Mt. Kopaonik (Drensky 1936)
68	*Zelotes oblongus* (C.L. Koch, 1833)	Gazimestan, Prishtinë (Stojićević 1929)
69	*Zelotes similis* (Kulczyński, 1887)	Pejë (Grimm 1985)
	Sparassidae	
70	*Micrommata virescens* (Clerck, 1757)	Lubiqevë (Bresjančeva 1907, Drensky 1936), Pejë (Kolosváry 1938, 1940)
	Thomisidae	
71	*Ebrechtella tricuspidata* (Fabricius, 1775)	Nerodime (Stojićević 1929), Pejë (Kolosváry 1938, 1940)
72	*Ozyptila praticola* (C.L. Koch, 1837)	Monastery in the town of Deçan (Kolosváry 1938, 1940)
73	*Runcinia grammica* (C.L. Koch, 1837)	Lubiqevë (Bresjančeva 1907, Drensky 1936)
74	*Synema globosum* (Fabricius, 1775)	Mt. Kopaonik (Stojićević 1929, Drensky 1936)
75	*Thomisus onustus* Walckenaer, 1805	Lubiqevë (Bresjančeva 1907, Drensky 1936)
76	*Xysticus ferrugineus* Menge, 1876	Pejë (Kolosváry 1938, Nikolić & Polenec 1981)
77	*Xysticus kochi* Thorell, 1872	Sazli , Zveçan (Stojićević 1929)
	Salticidae	
78	*Dendryphantes rudis* (Sundevall, 1833)	Lebanë (Stojićević 1929)
79	*Evarcha falcata* (Clerck, 1757)	Prizren (Stojićević 1929)
80	*Heliophanus cupreus* (Walckenaer, 1802)	Mt. Kopaonik (Drensky 1936)
81	*Heliophanus flavipes* (Hahn, 1832)	Kaçanik, Sazli (Stojićević 1929), Mt. Kopaonik (Drensky 1936)
82	*Pellenes nigrociliatus* (Simon, 1875)	Prizren (Stojićević 1929)
83	*Philaeus chrysops* (Poda, 1761)	Mt. Kopaonik (Drensky 1936)
84	*Salticus scenicus* (Clerck, 1757)	Mt. Kopaonik (Drensky 1936)
85	*Sitticus pubescens* (Fabricius, 1775)	Nerodime (Stojićević 1929)
86	*Sitticus saxicola* (C.L. Koch, 1846)	Mt. Kopaonik (Drensky 1936)

berg Research Institute for providing laboratory facilities during this study; Julia Altman gave technical support during identification work. Dr. Christo Deltshev kindly revised this paper. We are grateful to Dr. Jason Dunlop who checked the English of this paper. We express our sincere acknowledgements to Theo Blick, Dr. Ambros Hänggi and Dr. Oliver-David Finch who provided important suggestions on the typescript. The German Academic Exchange Service (Deutscher Akademischer Austauschdienst, Bonn) supported B.V. with a three month visit in the Senckenberg Research Institute.

References

Bresjančeva J 1907 Prilog za poznavanje srpske aranijske faune. – Radovi iz Zoološkog Instituta u Univerzitetu, Belgrade 1 (2-3): 1-16

Deeleman-Reinhold C 1974 The cave spider fauna of Montenegro (Araneae). – Glasnevin Republic Zavoda Zaštitu Prirode, Titograd 6: 9-33

Deeleman-Reinhold C 1985 Contribution à la connaissance des Lepthyphantes du groupe pallidus (Araneae, Linyphiidae) de Yougoslavie, Grece et Chypre. – Mémoires de Biospéologie 12: 37-50

Deltshev C, Ćurčić BPM & Blagoev G 2003 The spiders of Serbia. Committee for Karst and Speleology - Serbian Academy of Sciences and Arts; Institute of Zoology -Bulgarian Academy of Sciences; Institute of Zoology - Faculty of Biology - University of Belgrade; Institute for Biological Research "Siniša Stanković" (co-publishers), Belgrade - Sofia. 833 pp.

Deltshev C, Ćurčić BPM, Dimitrijević R, Makarov S & Lučić L 1996 Further report on cave- and litter-dwelling spiders (Araneae, Arachnida) from Serbia, Yugoslavia. – Archives of Biological Sciences 48 (3-4): 25-26

Deltshev C, Vrenozi B, Blagoev G & Lazarov S 2011 Spiders of Albania – faunistic and zoogeographical review (Arachnida, Araneae). – Acta Zoologica Bulgarica 63: 125-144

Drensky P 1936 Katalog der echten Spinnen (Araneae) der Balkanhalbinsel. Opis na Paiatzite ot Balkanikia polouostrow. – Spisanie na Bulgarskata Akademiia na Naukite 32: 1-223

Grimm U 1985 Die Gnaphosidae Mitteleuropas (Arachnida, Araneae). – Abhandlungen des Naturwissenschaftlichen Vereins in Hamburg 26: 1-318

Heimer S & Nentwig W 1991 Spinnen Mitteleuropas: Ein Bestimmungsbuch. Paul Parey, Berlin. 543 pp.

Helsdingen PJ van 2012 Araneae. In: Fauna Europaea Database, version 2012.2 – Internet: http://www.european-arachnology.org/reports/fauna.shtml [accessed at 25 December 2012]

Knoflach B 1996 Die Arten der *Steatoda phalerata*-Gruppe in Europa (Arachnida: Araneae, Theridiidae). – Mitteilungen der Schweizerischen Entomologischen Gesellschaft 69: 377-404

Kolosváry G 1938 Sulla fauna aracnologica della Jugoslavia. – Rassegna faunistica 16 (3-4): 61-81

Kolosváry G 1940 Neuere Angaben zur Spinnenfauna Siebenbürgens. – Folia Zoologica et Hydrobiologica 10: 112-114

Kraus O 2006 Arachnologie im Senckenberg: von Wider bis Wiehle. – Arachnologische Mitteilungen 32: 1-7 – doi: 10.5431/aramit3201

Metzner H 1999 Die Springspinnen (Araneae, Salticidae) Griechenlands. – Andrias 14: 1-279

Nentwig W, Blick T, Gloor D, Hänggi A & Kropf C 2013 Spiders of Europe, version 2.2013. – Internet: http://www.araneae.unibe.ch [accessed at 13 February 2013]

Nikolić F & Polenec A 1981 Catalogus Faunae Jugoslaviae III/4 Aranea. Consilium Academiarum Scientiarum Rei Publicae Socialisticae Foederativae Jugoslaviae, Ljubljana. 135 pp.

Platnick NI 2013 The world spider catalog, version 14.0. American Museum of Natural History. – Internet: http://research.amnh.org/entomology/spiders/catalog/index.html [accessed at 09 September 2013]

Roberts MJ 1987 The spiders of Great Britain and Ireland, Volume 2: Linyphiidae and check list. Harley Books, Colchester. 204 pp.

Roberts MJ 1995 Collins Field Guide: Spiders of Britain & Northern Europe. HarperCollins, London. 383 pp.

Stojićević D 1929 [Les araignées de Serbie. Araneae Sund.]. – Glasnevin Museum de Historia Natural, Beograd 19: 1-65

Tongiorgi P 1966 Italian wolf spiders of the genus *Pardosa* (Araneae: Lycosidae). – Bulletin of the Museum of Comparative Zoology, Harvard University 134: 275-334

Vrenozi B 2012 A collection of spiders (Araneae) in Albanian coastal areas – Arachnologische Mitteilungen 44: 41-46 – doi: 10.5431/aramit4407

Vrenozi B & Dunlop JA 2013 Albanian arachnids in the Museum für Naturkunde, Berlin. – Arachnology 16: 10-15

Vrenozi B & Haxhiu I 2008 [Data on order Araneae (Class Arachnida) in the Western Adriatic Lowland]. – Proceedings of International Conference on Biological and Environmental Sciences, 26–28 September 2008, Faculty of Natural Sciences, Tirana, Albania. pp. 297-301 [in Albanian]

Vrenozi B & Jäger P 2012 A faunistic study on ground-dwelling spiders (Araneae) in the Tirana district, Albania. – Arachnologische Mitteilungen 44: 81-87 – doi: 10.5431/aramit4412

Sensory structures and sexual dimorphism in the harvestman *Dicranopalpus ramosus* (Arachnida: Opiliones)

Hay Wijnhoven

doi: 10.5431/aramit4605

Abstract. A survey on sensory organs of both sexes of the harvestman *Dicranopalpus ramosus* classifies structure and frequency of campaniform sensilla, falciform setae, sensilla basiconica, slit sensilla, solenidia, spines, sensilla chaetica, trichomes (simple hairs) and plumose setae. Sensilla are equally distributed on the pedipalp tarsi of both males and females, but females show higher counts of campaniform and falciform setae than males. Females furthermore have about 1000 glandular plumose setae on each pedipalp, that at the same positions in males are replaced by sensilla chaetica. The walking legs of both sexes show a similar distribution of sensory organs, with females showing more sensilla basiconica at the legs I and II and more solenidia on the first pair of legs. Males have a large number of bipterate setae (about 2200 per specimen) at the metatarsi and tarsi of the third and fourth pair of legs. In females these are replaced by simple hairs. Although females show a similar (or slightly higher) number of leg sensilla than males, their density is higher due to their shorter legs. In both sexes the second pair of legs has the largest number of falciform setae, sensilla basiconica, chaetica and solenidia, followed by the legs I, III and IV. The first pair of legs has the highest density of falciform setae, sensilla basiconica and solenidia, followed by the legs II, III and IV. The genital operculum, sternites and tergites show a multitude of slit sensilla. The slit sensilla of the genital operculum and sternites are associated with insertion plaques of muscles operating the penis/ovipositor and regulating opisthosomal volume and hemolymph-pressure.

Keywords: bipterate setae, harvestmen, plumose setae, sensory structures, sexual dimorphism

Zusammenfassung. Sinnesorgane und Sexualdimorphismus der Weberknechtart *Dicranopalpus ramosus* (Arachnida: Opiliones). Im Rahmen einer Untersuchung der Sinnesorgane beider Geschlechter der Weberknechtart *Dicranopalpus ramosus* werden die Struktur und Anzahl der Kuppelsensillen (campaniform), sichelförmigen Borsten (falciforme Setae), Riechkegel (Sensilla basiconica), Spaltsensillen, Solenidien (röhrenförmige Setae) und Dornen sowie der Haarsensillen (Sensilla chaetica), Trichome (einfache Haare) und federförmige Haare (plumose Setae) beschrieben. Die Pedipalpen-Tarsen der männlichen und weiblichen Tiere weisen identische Verteilungen der Sensillen auf, wobei die Weibchen mehr Kuppelsensillen und sichelförmige Borsten besitzen als die Männchen. Weiterhin konnte festgestellt werden, dass auf jedem weiblichen Pedipalpus 1000 gefiederte Drüsenhaare (glandulare plumose Setae) vorkommen, wohingegen bei den Männchen an den gleichen Stellen Haarsensillen vorgefunden werden. Die Beine beider Geschlechter weisen eine ähnliche Verteilung der Sinnesorgane auf, wobei Weibchen mehr Riechkegel in den Beinen I und II und mehr Solenidien am ersten Beinpaar aufweisen. Männliche Tiere besitzen eine große Anzahl zweiflügeliger Borsten (bipterate Setae) (insgesamt ca. 2200 pro Tier) auf den Metatarsen und Tarsen des dritten und vierten Beinpaares . An gleicher Stelle sind bei weiblichen Tieren einfache Haare vorzufinden. Weibchen besitzen eine ähnliche (oder höhere) Anzahl an Beinsensillen als Männchen. Da die Beine der weiblichen Tiere jedoch kürzer sind, stehen die Beinsensillen bei ihnen dichter. In beiden Geschlechtern weisen die zweiten Beinpaare die größte Anzahl an sichelförmigen Borsten, Riechkegeln, Haarsensillen und Solenidien auf, gefolgt von den ersten, dritten und vierten Beinpaaren. Auf den ersten Beinpaaren erreichen die sichelförmigen Borsten, Riechkegel und Solenidien die höchste Dichte, gefolgt von den zweiten, dritten und vierten Beinpaaren. Das Genitaloperculum, die Sternite und Tergite weisen eine Vielzahl von Spaltsensillen auf. Die Spaltsensillen des Genitaloperculums und der Sternite sind mit Muskelansätzen verbunden. Diese Muskeln steuern Penis bzw. Ovipositor und regeln das Opisthosoma-Volumen und den Hämolymph-Druck.

Harvestmen of the suborder Eupnoi primarily gather environmental information with their legs and pedipalps. Eyes are usually small and eyesight in most species is considered to be limited to the ability to distinguish changes in light intensity (Machado & Macías-Ordóñez 2007, Willemart & Hebets 2012). Walking is accomplished mainly by the first, third and fourth leg pairs. The first and second legs are also used to explore their surroundings, e.g. to find food or a mate. The second – and longest – legs have traditionally been called 'sensory legs', because harvestmen constantly wave them about conspicuously, exploring their surroundings by touch (Goodnight & Goodnight 1976, Hillyard & Sankey 1989). Willemart et al. (2009) stressed that the first legs are also important sensory tools, mainly used for fine recog-

Hay WIJNHOVEN, Groesbeeksedwarsweg 300, NL-6521 DW Nijmegen, Netherlands. E-mail: hayw@xs4all.nl

submitted 11.9.2013, accepted 18.10.2013, online 9.11.2013

Fig. 1: A *Dicranopalpus ramosus* male (left) touches a female with the dorsal side of his left pedipalpal tarsus. Understanding intersexual interactions like this requires knowledge of topography and function of sensory organs. Note the dimorphism in pedipalpal proportions and colouration. Photo Jörg Pageler, Oldenburg, Germany.

nition. Thus it might be expected that most sensilla types are located on the appendages and that each leg pair may contain a specific set and density of sensory organs.

Males and females may exhibit differences in sensory organ types and/or densities. Sexually dimorphic structures are usually indicative of a sexual role and often the result of sexual selection (Macías-Ordóñez et al. 2010, Willemart & Giribet 2010). In many Phalangioidea the pedipalps, chelicerae and/or legs are sexually dimorphic; as has been well documented in numerous taxonomic papers (e.g. Martens 1978). Male pedipalps can be modified for clasping the female during mating (many Phalangiidae and Sclerosomatidae; Macías-Ordóñez et al. 2010). Male chelicerae (e.g. *Phalangium opilio* Linnaeus, 1761) can be modified for intrasexual contests (Willemart et al. 2006). In general, legs are longer in males than in females (Martens 1978).

Accounts of sensory biology in harvestmen are scarce, and until now no attempt has been made to depict all sensory structures of one particular species of Opiliones. This study aims at describing and illustrating the diversity and topography of sensory structures (except eyes) of both the male and female of *Dicranopalpus ramosus* (Simon, 1909) – a distinctly sexually dimorphic harvestman – based on light microscopy. Additionally, reproductive structures are described and illustrated.

Dicranopalpus ramosus

The genus *Dicranopalpus* Doleschall, 1852 belongs to the superfamily Phalangioidea (suborder Eupnoi), presently comprising five recognised families: Phalangiidae, Sclerosomatidae, Neopilionidae, Monoscutidae and Protolophidae (Cokendolpher & Lee 1993), as well as a few taxa of uncertain affinities. Mainly because the families are poorly delimited (Giribet et al. 2002, Hedin et al. 2012) the position of *Dicranopalpus* within Phalangioidea is still uncertain. Currently, *Dicranopalpus* belongs to the so called *Dicranopalpus* group, containing seven genera (Crawford 1992, Pinto-da-Rocha & Giribet 2007).

The harvestman *D. ramosus* originates from the Western Mediterranean region (Morocco, Spain, Portugal, southern part of France). Since around 1990 it has been steadily moving north from its original range. Thus far, *D. ramosus* has additionally been recorded from southern England and France (Sankey & Storey 1969), the Netherlands (Cuppen 1994, Noordijk et al. 2007), Belgium (Slosse 1995), Ireland (Cawley 1995), Scotland (Hillyard 2000), Germany (Schmidt 2004) as far north as Denmark (Toft & Hansen 2011), and it has built up stable populations in most of these countries so far as Atlantic climatic conditions prevail.

Adults of *D. ramosus* are primarily arboricolous, living on trees, shrubs and hedges in a wide variety of artificial, semi-natural and natural habitats (Noordijk

et al. 2007). In *D. ramosus*, the colouration of body, chelicerae and pedipalps is sexually dimorphic (Figs. 1, 6), as well as the shape of the pedipalps. The female has shorter legs and develops a distinct dorsal protuberance.

Material and methods

Sources of material – All observations are based on 46 adult males and 53 adult females that were collected by the author in Nijmegen (N: 51°50´20´´, E: 5°52´25´´, ca. 40 m a.s.l.) the Netherlands from 11-x-2011 to 6-xii-2011.

Microscopic preparations – Specimens were preserved in 70% ethanol prior to preparation. For quantitative analyses 10 (left or right) pedipalps, chelicerae or legs of different male and female individuals were randomly selected from the material. The appendages to be studied under the microscope were bisected along their long axis, in the dorsoventral as well as in the mediolateral plane, with a fine surgical razor blade (leg tarsi were not dissected). All inner tissues were then carefully removed by scraping them out using the same blade or a fine pointed wooden toothpick. No staining or clearing was applied. The objects were embedded in water, mounted temporarily on microscope slides, and examined (under oil immersion for magnifications of 400 and 1000x) on an Olympus stereo light microscope (40/100/400/1000x).

Illustrations – All illustrations were based on sketches directly drawn from the microscope with the aid of a calibrated drawing mirror.

Microscopic photography – Objects were cleared in KOH and mounted on microscope slides. Photos were taken with an Olympus BX-40 microscope equipped with an Olympus DP 70 digital microscope camera, using 10x, 20x, 40x and 100x Olympus lenses and transmitted light or phase contrast. Recording of the photographs and length measurements were made using the software Olympus DP Controller 2002 (Olympus Optical Co, Ltd). The software was calibrated to provide proper length measurements. Photographs were enhanced with Adobe Photoshop CS3 software by adjusting contrast and removing small debris particles in the background.

Statistical analysis – To determine if the means of sampled male and female sensory structures were significantly ($p<0.05$) different from one another a two-sample t-test assuming equal variances was used.

Results

Definitions and descriptions of sensory sensilla and setae

Fig. 2 illustrates the sensory sensilla and setae types found in *D. ramosus*. Abbreviations used in illustrations and photos: bas = sensillum basiconicum/sensilla basiconica; bi = bipterate seta/setae; cam = campaniform sensillum/sensilla; ch = sensillum chaeticum/sensilla chaetica; CO = coxa; fal = falciform seta/setae; FE = femur; MT = metatarsus; PA = patella; pl = plumose seta/setae; sl = slit sensillum/sensilla; sol = solenidium/solenidia; sp = spine(s); TA = tarsus; TI = tibia; TRO = trochanter; tr = trichome(s).

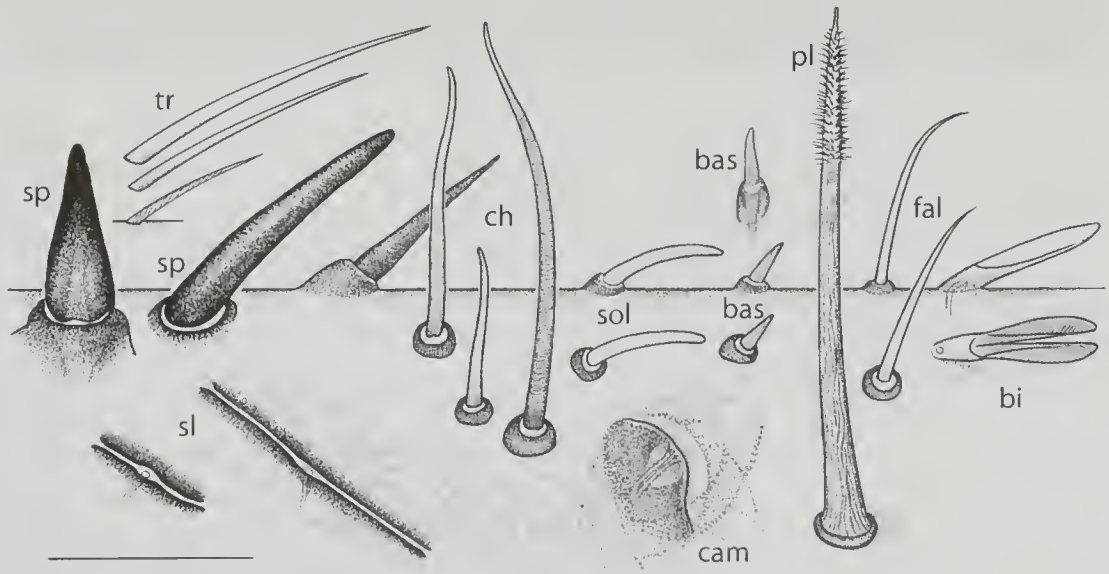


Fig. 2: Sensory structures and setae in *D. ramosus* with abbreviations used in figures (right is distal direction). From left to right: 2 spines (sp), 3 trichomes (tr), 2 slit sensilla (sl), 4 sensilla chaetica (ch), 2 solenidia (sol), 1 campaniform sensillum (cam), 3 sensilla basiconica (bas), 1 plumose seta (pl), 2 falciform setae (fal), 2 bipterate setae (bi). Scale bar: 50 µm.

Fig. 3: Bipterate setae in *D. ramosus* dorsally on male metatarsus leg III. A. Trichomes and 4 bipterate setae; B. Diagram of internal structure of bipterate setae with internal globular bodies (glb); C. Topography and density of bipterate setae (large open dots) and trichomes (small dots) on a dorsal section of metatarsus leg III. Top of the figure is the posterior direction, arrow indicates dorsal midline of metatarsus. Scale bar: A, B = 25 µm; C = 50 µm.

Bifid metatarsal spine (Figs. 10a, 11) – A previously unknown type of hair sensillum (see Legs, Metatarsus). It is inserted in a socket membrane and has two fused, dark coloured shafts, one short, with a blunt end (app. 15 µm), the other long and tapering (app. 45 µm).

Bipterate setae (Figs. 2, 3, 5c, 5d, 10) – First mentioned as 'flat setae' by Willemart et al. (2009). A more appropriate new name for this sensillum type ('bipterate' seta) is proposed here, meaning 'double-winged' (while 'flat setae' are defined as flattened, non-bifid setae). The insertion of the short cylindrical shaft is rigid, the shaft widens slightly towards a distal portion of two delicately striated, concavely curved 'wings'. The angle of insertion is about 25° and the length is approximately 40 µm. Bipterate setae have elaborate internal structures but their description requires more sophisticated microscopic techniques. Fig. 3b illustrates what can be seen with light microscopy. At the junction of shaft and wings each seta seems to have some kind of micropore, which connects via a canal with an internal globular body of unknown substance (in one collected specimen the globular inner structures were clearly discernible because they had turned red as a result of some chemical reaction; later the red

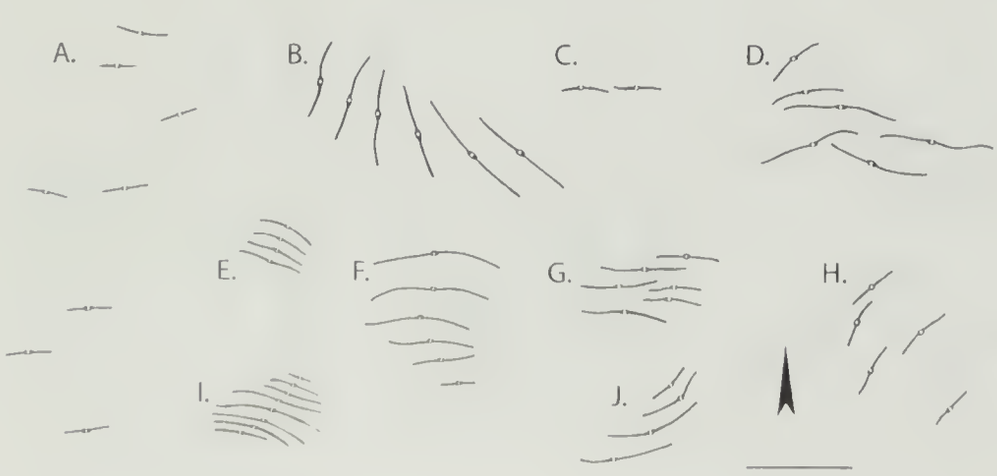


Fig. 4: Slit sensilla groups in *D. ramosus*. A. Male genital operculum, left side; B. Male left chelicera, near the dorsal junction of the second and third segment; C. Female ovipositor, ventral right side; D. Male pedipalpal femur; E. Female trochanter leg I; F. Female coxapophysis leg II; G. Female pedipalpal femur; H. Male left chelicera, first segment; I. Female trochanter leg IV, posterior side; J. Female pedipalpal trochanter. For all slit groups the arrow points towards the distal region of the mentioned body part. Scale bar: 50 µm.

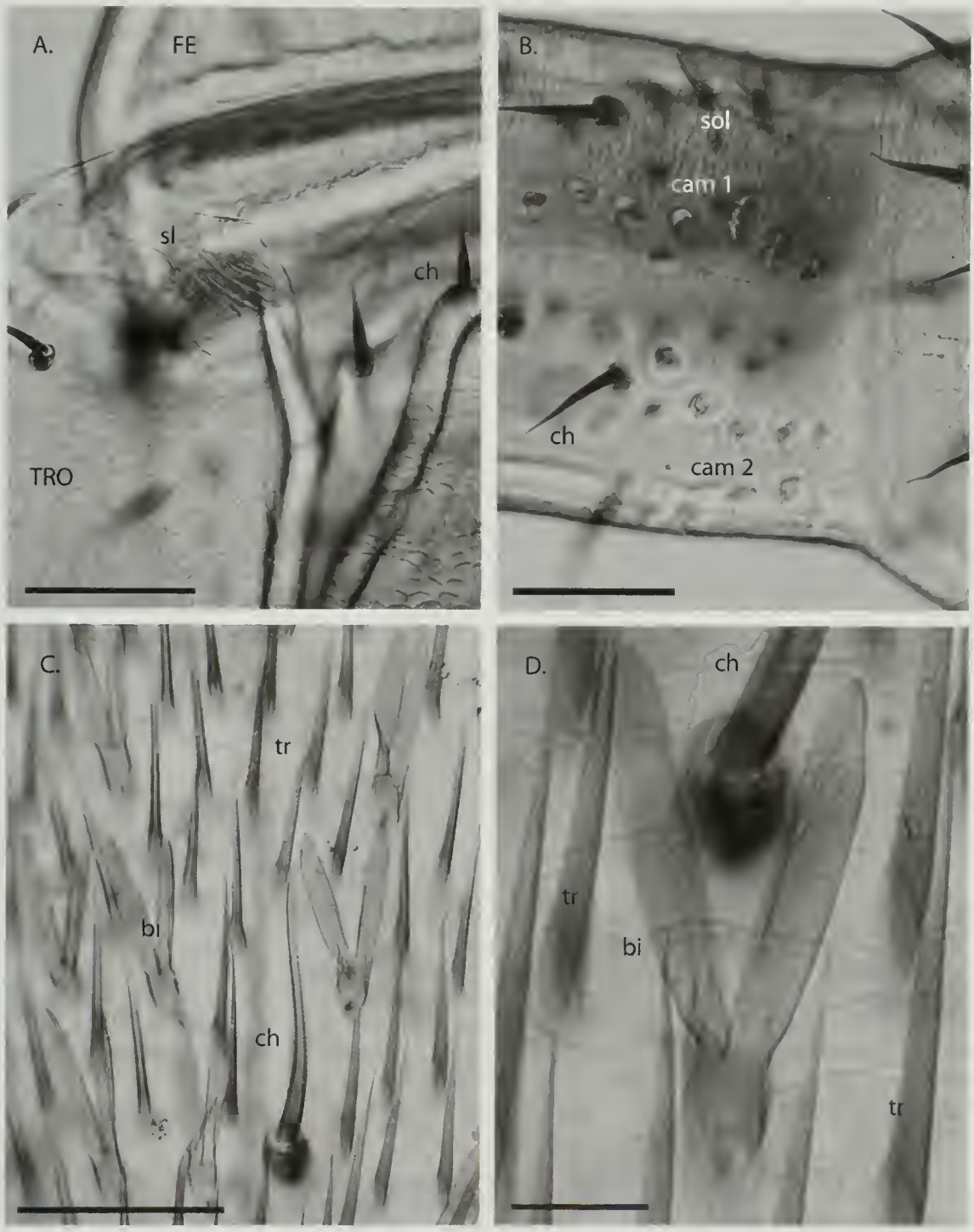


Fig. 5: A. Posterior slit group on trochanter of male leg I. Scale bar 100 µm; B. Proximal region of right male leg III, with an anterior (cam 1) and a V-shaped (cam 2) ventral campaniform sensilla group and 2 solenidia. Scale bar 100 µm; C. Bipterate setae dorsally on metatarsus of male leg III. The sensillum chaeticum has transverse striae. Scale bar 40 µm; D. One bipterate seta, showing striated wings and spirally striate trichomes. Scale bar: 10 µm. Photos Walter Pfliegler (Debrecen, Hungary).

colour vanished). The globular bodies are probably innervated.

Slit sensilla (Figs. 2, 4, 5a, 6-11, 13) – Slit sensilla appear as elongated depressions in the cuticle, the dendrite attachment site in the centre of the slit showing as a transparent 'pore' under the microscope. Also, slits can be surrounded by a dark brown, oval shaped sclerotized zone of exocuticle and frequently the endocuticle is thickened on both sides of the slit. The associated dendritic sheath is often visible. Slits are very small (15 µm) to large (60 µm), and stand isolated or in loose to dense groups of up to 8 slits depending on their location (Fig. 4). Most slits are oriented approximately perpendicular to the long axis of the appendage.

Campaniform sensilla (Figs. 2, 5b, 7-10) – Campaniform sensilla (also called campaniform organs) are circular to oval structures in the cuticle with a curved slit approximately 15 to 30 µm wide. The light microscopic image reveals details of an inner structure of round or oval shape. This makes them easy to identify, although on the leg metatarsi (Fig. 10) three or four campaniform sensilla occur with a shape approaching that of the slit sensilla. Unlike slit

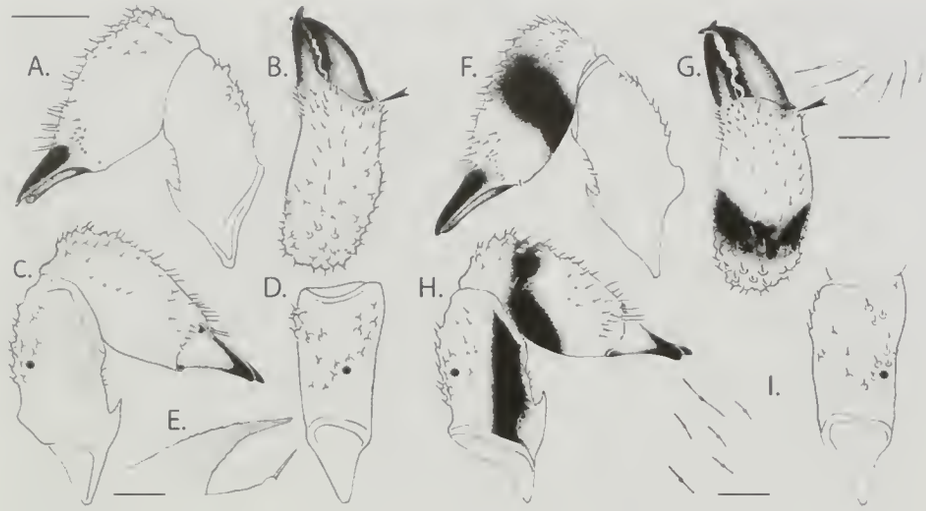


Fig. 6: Right chelicerae of *D. ramosus* showing sensilla chaetica and slit sensilla groups; A-E. Male; F-I. Female. A. Median view; B. Dorsal view of distal portion (arrow indicates location of slit group); C. Lateral view; D. Dorsal view of first cheliceral segment; E. Detail of ventral spur; F. Median view; G. Dorsal view of distal portion and group of slit sensilla associated with the dorsal articulation of the cheliceral finger (arrow indicates location of slit group); H. Lateral view; I. Dorsal view of first cheliceral segment and group of slit sensilla. Asterisk indicates location of slit group. Note sexual differences in colouration. Scale bars: chelicerae (top left) = 0.5 mm; E and slits = 50 µm.

sensilla the campaniform organs have an asymmetrical makeup. Both ends of the curved campaniform slit are always directed proximally, the campaniform slit opening is in the distal region while the dendrite attachment site is on the proximal side (Fig. 2). The campaniform slit is oriented at an angle of 45° to 90° relative to the long axis of the appendage. As with slit sensilla, the campaniform sensilla can stand isolated or in loose to dense groups of up to 10 sensilla.

Sensilla chaetica (Figs. 2, 3, 5-14) – Several varieties were found. They all have in common the fact that the shaft inserts into a large socket membrane. In some cases the seta is placed on top of a tubercle. The angle of insertion is 20° to 90°. On the leg metatarsi, tarsi and pedipalpal tarsi sensilla with highly variable shaft lengths occur (35–120 µm long), with the distal portion often curved upward, extending beyond the trichomes (Fig. 7C); they are transversely striated and appear more transparent than the sensilla chaetica on the leg femora, patellae and tibiae, indicating that they may have thinner shaft walls.

Falciform setae (Figs. 2, 7, 12) – They resemble sensilla chaetica, but are thinner, generally shorter (app. 50 µm) with a fine pointed tip and the basal socket has a smaller diameter. Falciform setae are inserted into the cuticle at an approximate right angle and their shafts are characteristically curved in a distal direction. No striae could be detected. Under the light microscope they appear to be more transparent than sensilla chaetica, suggesting that they have thinner shaft walls.

Plumose setae (Figs. 2, 9) – Glandular setae, rigidly inserted into the cuticle at an approximately straight angle on a heavily sclerotized ring-shaped socket of about 18 µm diameter. Their length is 90–120 µm. The shaft exhibits rugose longitudinal striae, presumably with some wall pores, although this latter aspect could not be determined with certainty. The plumose distal portion is not striated and is covered with minute hairs. Broken plumose setae reveal a thin shaft wall.

Sensilla basiconica (Figs. 2, 7, 8, 12) – In this contribution sensilla basiconica (also referred to as 'basiconica') are defined as setae with a short, rigid pointed shaft (app. 8–15 µm), inserted into a socket membrane. The angle of insertion is 20° to 90°. Because of their small size, similarity to broken setae and isolated occurrences they are easily overlooked. They also are often obscured by surrounding trichomes. In *D. ramosus* these setae typically appear isolated or in close-set groups of two or three.

Solenidia (Figs. 2, 5b, 7, 8j, 10a, 12c) – Defined as setae inserted within a socket membrane at an angle of 20° to 45°, having an obtuse end ('sausage-like'). They measure about 35 µm and are characteristically curved towards the integument. Also, they appear as transparent, thin-walled setae, whereas most other setae (like sensilla chaetica and trichomes) have thicker walls and as a result appear darker.

Spines (Figs. 2, 8i, 10-12, 14) – Spines are large, heavily sclerotised setae inserted in a socket membrane. One type is robust and blunt (40 µm long; Figs. 2, 8I) another type is more slender (75 µm long; Figs. 2, 8i, 10-12, 14).

Trichomes (Figs. 2, 3a, 3c, 5c, 5d, 7c, 10a, 11) – Hairs without a socket membrane, their shafts insert directly into the cuticle. They measure approximately 40 µm and the angle of insertion is about 20° to 30°. Trichomes show a tendency of being longer and thicker towards the distal regions of the leg meta-

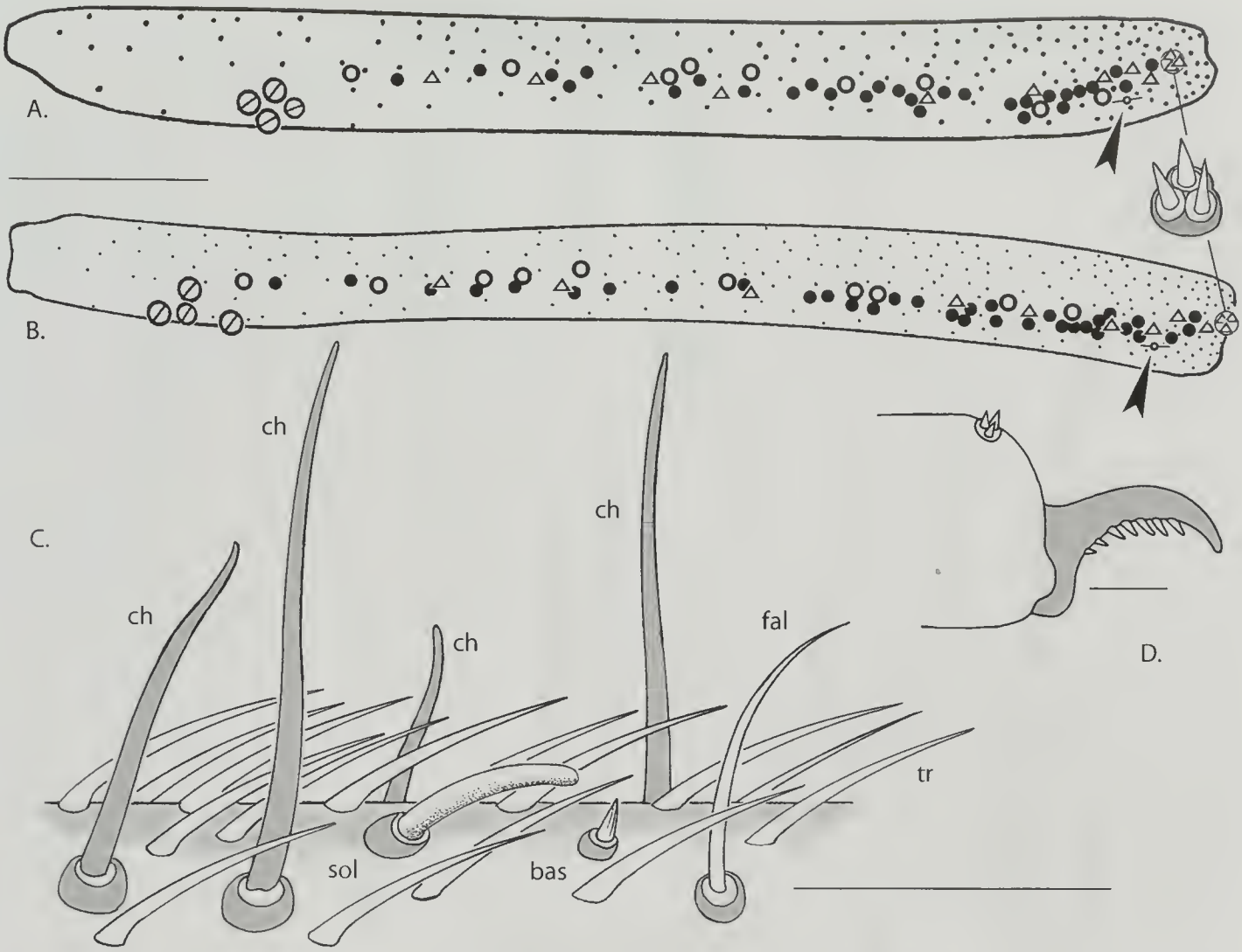


Fig. 7: A. Topography of sensilla on male right pedipalpal tarsus (trichomes not drawn; right is distal direction; based on spread-out dorsal portion of bisected tarsus): campaniform sensilla (large open dots; midline indicates orientation of the slit), falciform setae (open dots), sensilla basiconica (triangles), sensilla chaetica (small dots), solenidia (large black dots), a single slit sensillum proximally of the tip (arrow) and group of 3 basiconica; B. Female pedipalpal tarsus (symbols see A.); C. Diagrammatic representation of dorsal region of left pedipalpal tarsus (right is distal direction) showing 4 sensilla chaetica and one falciform seta extending beyond the trichomes, whereas the solenidium and sensillum basiconicum are concealed within a dense cover of trichomes; D. Lateral view of palpal tarsus with pectinate claw and location of distal basiconica group (other sensilla not drawn). Scale bars: A, B = 0.25 mm; C, D = 50 µm.

tarsomeres and tarsomeres, with maximum lengths of about 90 µm. At the ventral sides of the distal leg tarsomeres trichomes form a brush-like, dense cover of long, often curved setae. The shafts of some trichomes are distinctly spirally striate (Figs. 2, 3, 5d).

Distribution of sensilla on the appendages

Chelicerae

Male chelicera (Figs. 4b, 4h, 6, 13a) – Basal segment with ventral spur (Figs. 6c, e). The only type of seta present is the sensillum chaeticum, occurring mainly on the dorsal, lateral and median sides; dorsally placed on top of a tubercle. The longest sensilla chaetica are located near the gap, proximally of the cheliceral fingers. At the articulation of the movable finger the second segment has a group of 6 slits (Figs. 4b, 6b). This represents the slit group with the longest slits found in *D. ramosus*. On the basal cheliceral segment a group of 5 or 6 small slit sensilla is located, in a dorsolateral position (Figs. 4h, 6d) set at an approximate angle of 45° relative to the long axis of the appendage.

Female chelicera (Figs. 6f-i) – Arrangement of slit groups and sensilla chaetica as in the male.

Pedipalps

In both sexes the pedipalps are characteristic in that they have a small apophysis near the ventral base

Tab. 1: Mean numbers, standard deviation and range of four sensory structures on the pedipalpal tarsus of *D. ramosus* (n = 10 males, 10 females). Numbers in bold represent significant differences (p<0.05).

Sensillum type	Male			Female			t-test
	Mean	SD	Range	Mean	SD	Range	P
Campaniform sensillum	10.2	1.33	8-12	15.4	0.92	14-17	**<0.001**
Falciform seta	9.6	1.02	8-11	12.5	1.02	10-14	**<0.001**
Sensillum basiconicum	11.3	1.19	10-14	11.3	0.78	10-12	0.84
Solenidium	31.0	1.79	29-34	32.4	1.20	30-34	0.07

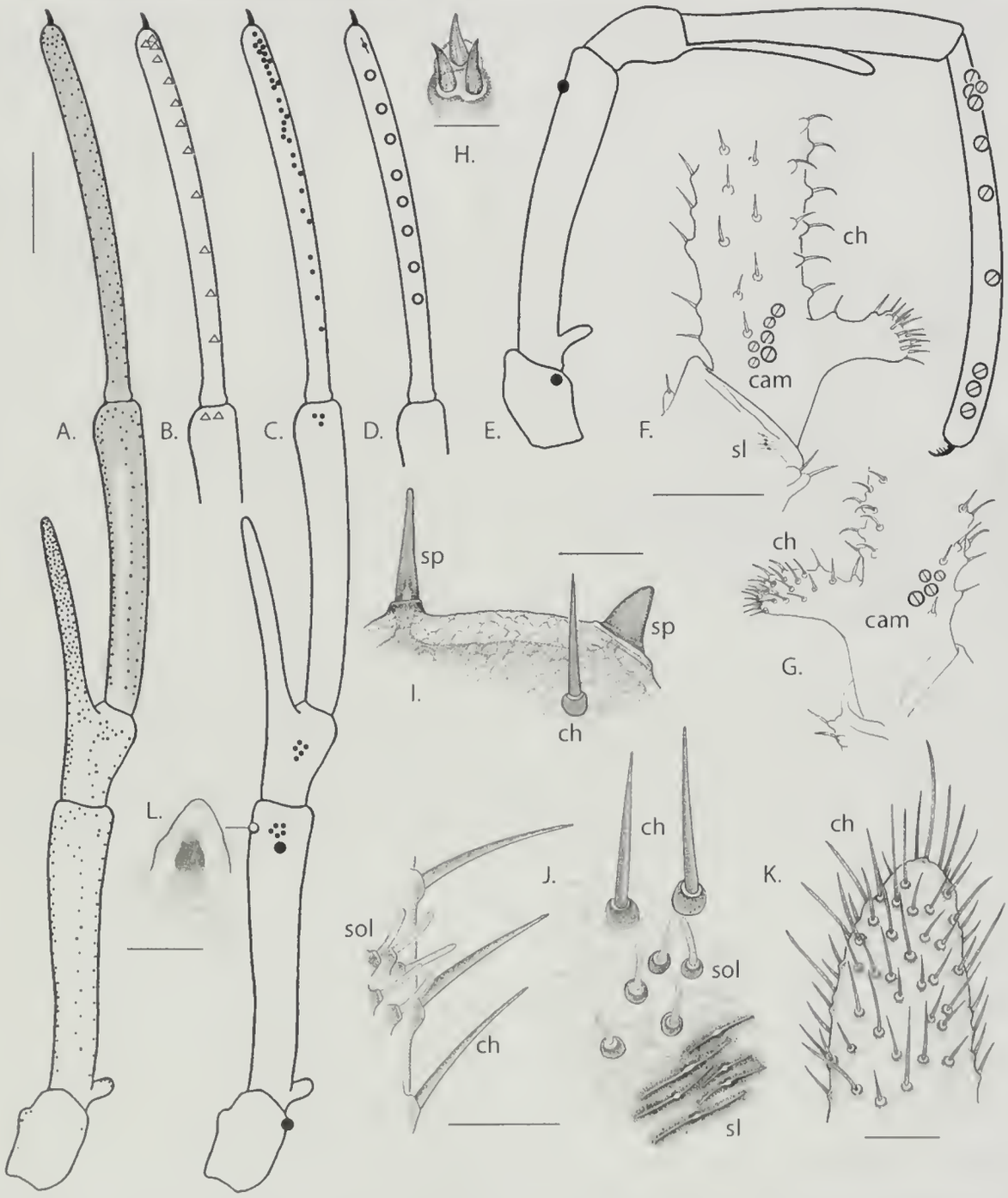


Fig. 8: Topography of trichomes and sensilla types on male pedipalp *D. ramosus*; A-D. Dorsal view of right pedipalp. A. Trichomes (grey area) and sensilla chaetica (dots); B. Sensilla basiconica; C. Solenidia (small dots) and two slit groups (large dots); D. Falciform setae and single slit sensillum near the tip; E. Lateral view of right pedipalp with slit groups (black dots) and campaniform sensila (open dots, midline indicates orientation of slit; slits not drawn to scale); F. Lateral view of trochanter with slit group, and proximal region of femur with sensilla chaetica and 6 campaniform sensilla; G. Median view of femur with sensilla chaetica and 4 campaniform sensilla; H. Group of 3 close set sensilla basiconica dorsodistally on tarsus; I. Distal margin of femur; J. Solenidia associated with a slit group, and sensilla chaetica on femur, lateral view (left; slits not visible), dorsal view (right); K. Tip of patellal apophysis; L. Blunt spine-like projection. Scale bars: A-E (vertical bar) = 0.5 mm; F, G = 0.25 mm; H = 12 µm; I-L = 50 µm.

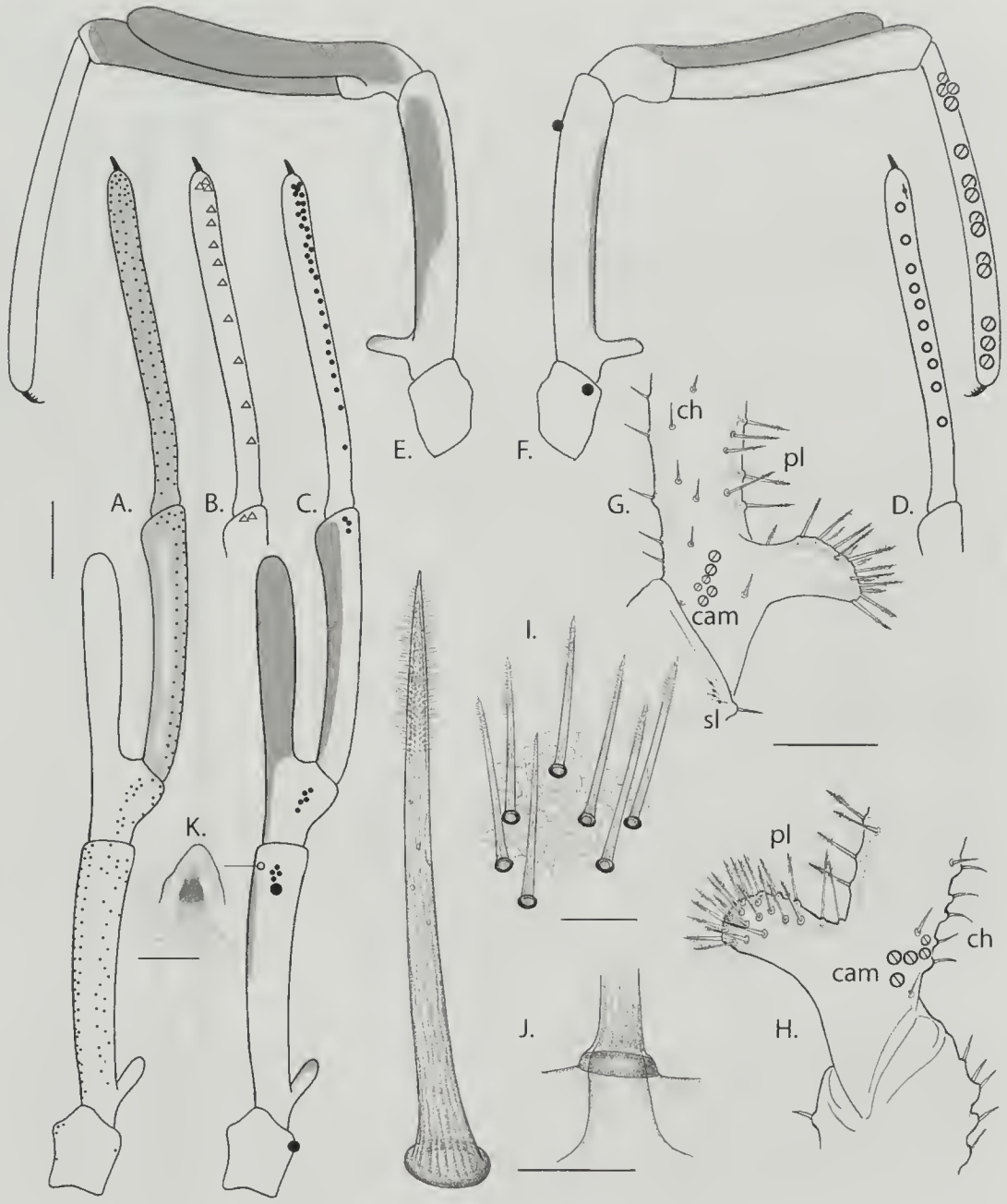


Fig. 9: Topography of trichomes, plumose setae and sensilla types on female pedipalp *D. ramosus*; A-D. Dorsal view of right pedipalp. A. Trichomes (light grey area) and sensilla chaetica (dots); B. Sensilla basiconica; C. Solenidia (small dots), plumose setae (dark grey area) and two slit groups (large dots); D. Falciform setae and single slit sensillum near the tip; E. Median view of right pedipalp with plumose setae (grey area); F. Lateral view of right pedipalp with slit groups (large dots), plumose setae (grey area) and campaniform sensilla (open dots, midline indicates orientation of slit; slits not drawn to scale); G. Lateral view of trochanter with slit group, and proximal region of femur with sensilla chaetica, plumose setae and 6 campaniform sensilla (open dots); H. Median view of proximal femur with sensilla chaetica, plumose setae and 5 campaniform sensilla; I. Plumose setae on patellal apophysis; J. Left: a plumose seta, right: lateral view of proximal part of plumose seta with glandular channel; K. Blunt spine-like projection. Scale bars: A-F = 0.5 mm; G, H = 0.25 mm; I, K = 50 µm; J = 25 µm.

of the femur and an extremely elongated apophysis on the median side of the patella. The pedipalps are highly sexually dimorphic

Male pedipalp (Figs. 7a, 8; Tabs. 5, 6) – Length 6.5 mm (6.2–6.8 mm; SD = 0.24; n = 10). One group of 4 slit sensilla laterodistally on the trochanter (Figs. 8c, e, f). One campaniform sensilla group (4 to 6 sensilla) at the median and one at the lateral base of the femoral apophysis (Figs. 8f, g). Distal region of femur with a group of 5 or 6 slits, accompanied by 4 or 5 solenidia (Fig. 8j). At the medial side of this slit/solenidia group an unidentified blunt, spine-like structure occurs (Fig. 8l). A group of 4 or 5 solenidia dorsally on the patella (Fig. 8c). The patellal apophysis is slender and pointed, densely and exclusively covered with sensilla chaetica of various lengths (Figs. 8a, k). The pedipalpal tarsus has a particularly rich assortment of sensory types. Among a cover of trichomes, numbers of basiconica, solenidia, falciform setae, campaniform sensilla and sensilla chaetica occur and close to its tip there is a single slit sensillum. Their distributions are shown in Fig. 7. The falciform setae comprise one irregular dorsal row. More to the dorsolateral side the basiconica and solenidia are arranged, with higher concentrations towards the tarsal tip. Campaniform organs are present as a group of 3 to 4 sensilla on the dorsolateral proximal region and as more or less isolated ones along the lateral (posterior) side of the tarsus (Figs. 7a, 8e). At the most dorsodistal tip of the pedipalpal tarsus a group of 3 close-set sensilla basiconica is located (Figs. 7a, d, 8b, h). No ventral row of spines on the tarsus. Pedipalpal claw pectinate

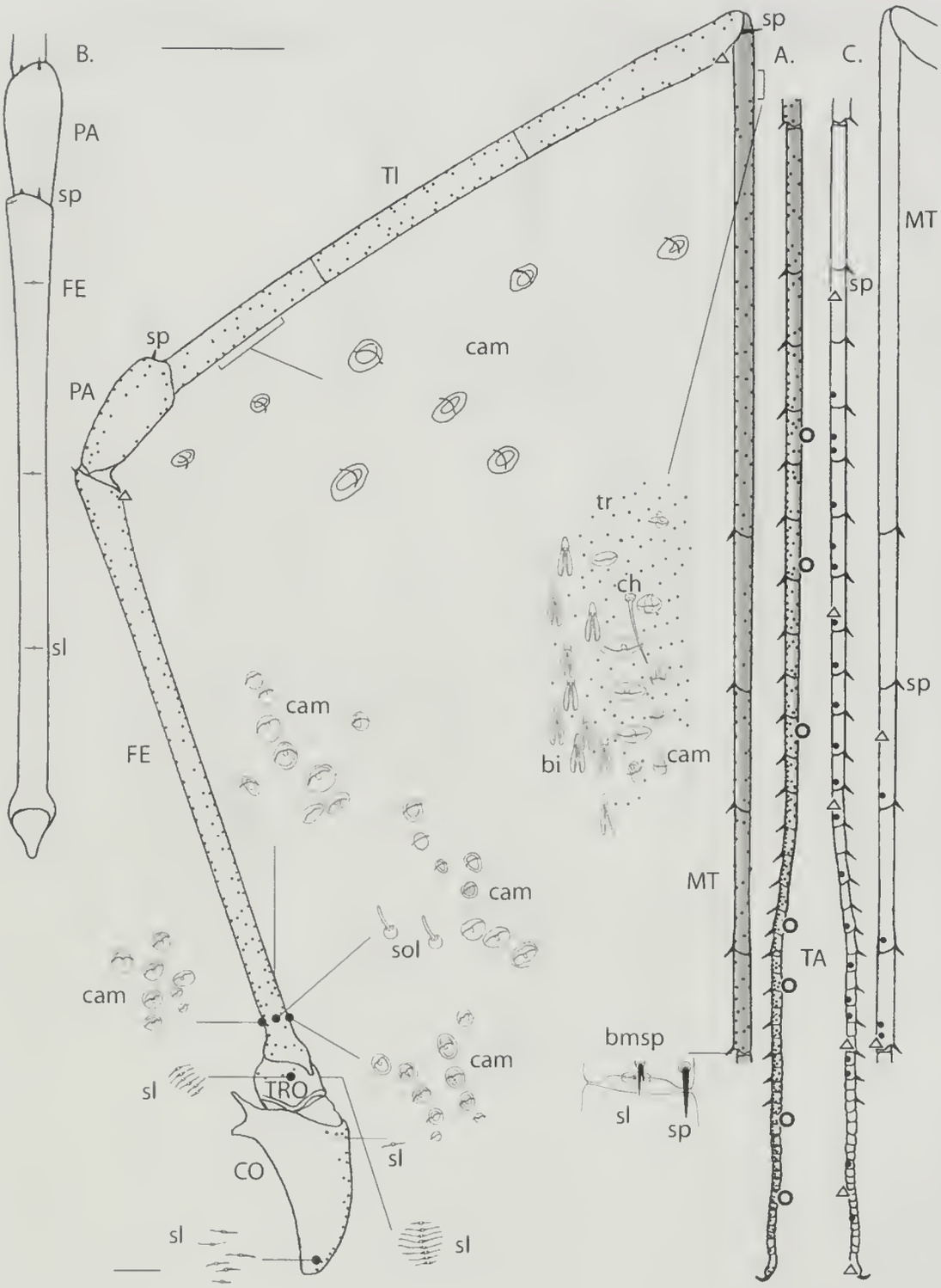


Fig. 10: Topography of sensory structures *D. ramosus* male left leg III. A. Anterior view with spines, sensilla chaetica (small dots), bipterate setae (grey area), falciform setae (open dots), 2 sensilla basiconica (triangle) and an isolated slit sensillum accompanied by a bifid metatarsal spine (bmsp); B. Dorsal view of left femur and patella showing spines and single slits; C. Posterior view of metatarsus and tarsus with sensilla basiconica (triangle) and solenidia (black dots). Orientation of details of campaniform sensilla groups and slit groups in direction of leg position. Some examples of spines (sp) are given. Scale bars: A-C (top) = 1 mm; details (bottom) = 50 µm.

(Fig. 7d). Tab. 1 summarises the numbers of sensilla on the pedipalpal tarsus.

Female pedipalp (Figs. 7b-d, 9; Tabs. 5, 6) – Length 6.8 mm (6.6-7.0 mm; SD = 0,13; n = 10). Topography of basiconica, solenidia, trichomes and falciform setae similar to the male. A distinctly sexually dimorphic feature is the large and rounded patellar apophysis. It is completely and densely covered with approximately 700 plumose setae (Fig. 9). No other sensilla types are found on the apophysis. Plumose setae also occur on the femoral apophysis (Figs. 9g, h), the median areas of the femur and tibia; total numbers per pedipalp exceed an estimated 1000. Within the plumose areas of the patella and tibia no sensilla chaetica appear. In all females examined, most of the distal plumose setae regions are partly covered with coagulated droplets or completely covered with a translucent sticky secretion. Cross sections of the patellal apophysis show that the plumose

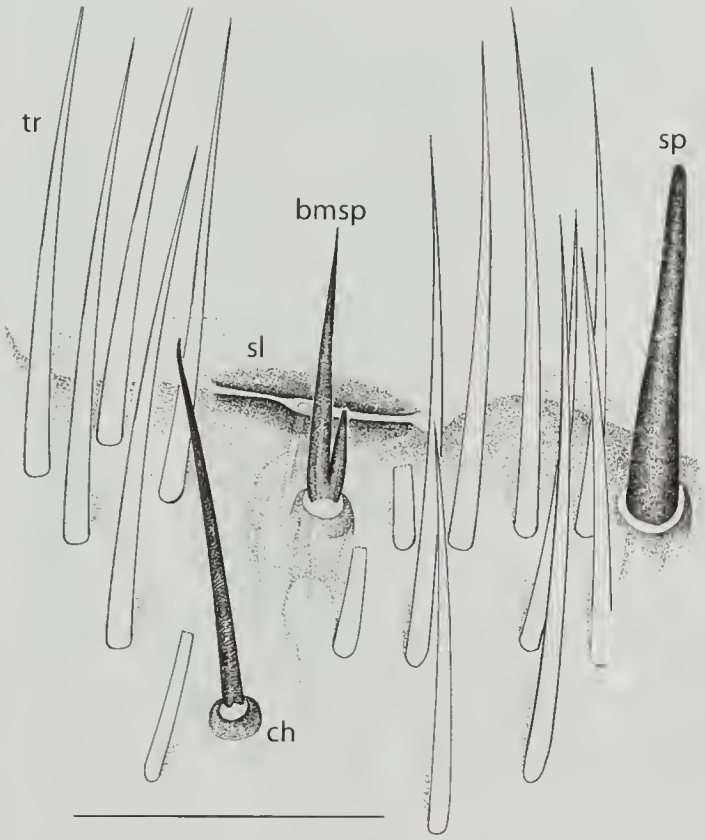


Fig. 11: Ventrodistal margin of metatarsus female right leg III with sensillum chaeticum, trichomes (some not drawn completely), one anterior spine, a single slit sensillum and a bifid metatarsal spine (bmsp). Scale bar: 50 µm.

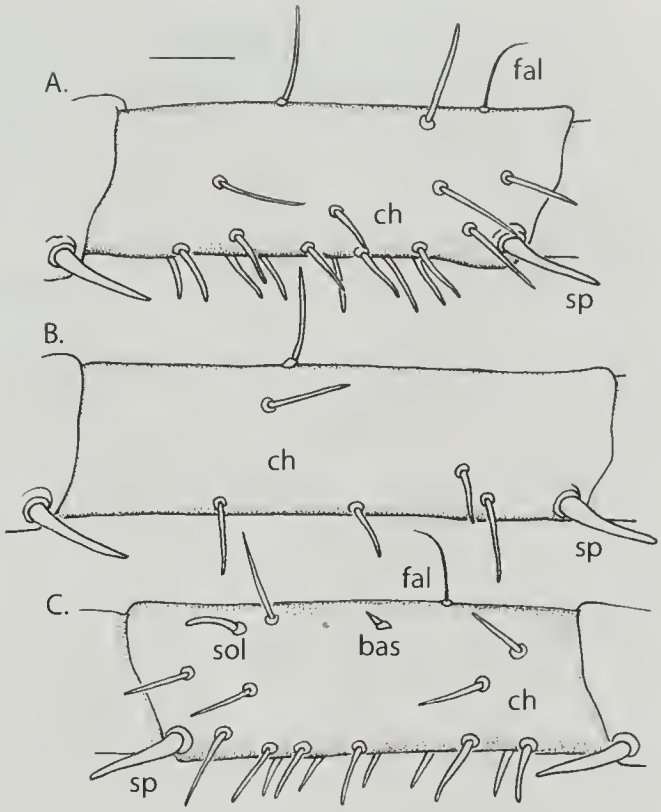


Fig. 12: Tarsomeres of left leg (trichomes not drawn). A. 15th tarsomere male leg I, anterior view, with many sensilla chaetica of the short type at its ventral side; B. 15th tarsomere male leg IV, anterior view; C. Diagrammatic posterior view of a tarsomere leg I, illustrating the most frequent topography of sensilla basiconica and solenidia. Scale bar: 50 µm.

setae are connected with internal glands, containing a yellowish secretion. The patellal apophysis can essentially be regarded as one large gland. Internal glandular tissues are also present in the femur and tibia.

As in the male there is a dorsal group of 3 close-set sensilla basiconica near the tip of the female pedipalpal tarsus and a single slit sensillum (Figs. 7b, d). The pedipalpal tarsus has 14 to 17 campaniform sensilla, with a proximal group of 4 or 5 and a distal one of 3, whereas the in-between sensilla are frequently arranged in pairs (Fig. 9f). Tab. 1 summarises the numbers of sensilla on the pedipalpal tarsus.

Legs

The tibia, metatarsus and tarsus have a variable number of pseudoarticulations or segments (Tab. 2). Male

Tab. 2: Mean leg lengths [mm] and standard deviation of 10 males and 10 females of *D. ramosus*. In parentheses the numbers of pseudoarticulations (tibia) or segments (metatarsus and tarsus).

		FE	PA	TI	MT	TA	Leg length	SD
Male leg nr.	I	5.9	1.2	6.3 (3-5)	8.6 (6-10)	8.8 (44-51)	30.7	1,72
	II	9.6	1.3	10.8 (7-10)	12.8 (11-16)	23.3 (86-93)	57.8	2,28
	III	5.1	1.2	5.4 (2-4)	8.4 (4-7)	9.7 (50-54)	29.8	1,12
	IV	6.9	1.2	7.4 (4-5)	11.4 (7-9)	13.5 (55-61)	40.4	2,00
Female leg nr.	I	4.7	1.0	5.0 (3-5)	6.4 (4-6)	7.3 (40-49)	24.4	1,63
	II	8.0	1.1	9.3 (7-10)	10.1 (10-13)	19.0 (75-90)	47.5	1,34
	III	4.2	1.0	4.5 (2-4)	6.1 (4-6)	7.5 (50-53)	23.3	2,10
	IV	5.8	1.0	6.3 (3-4)	9.1 (6-9)	11.3 (47-59)	33.5	1,45

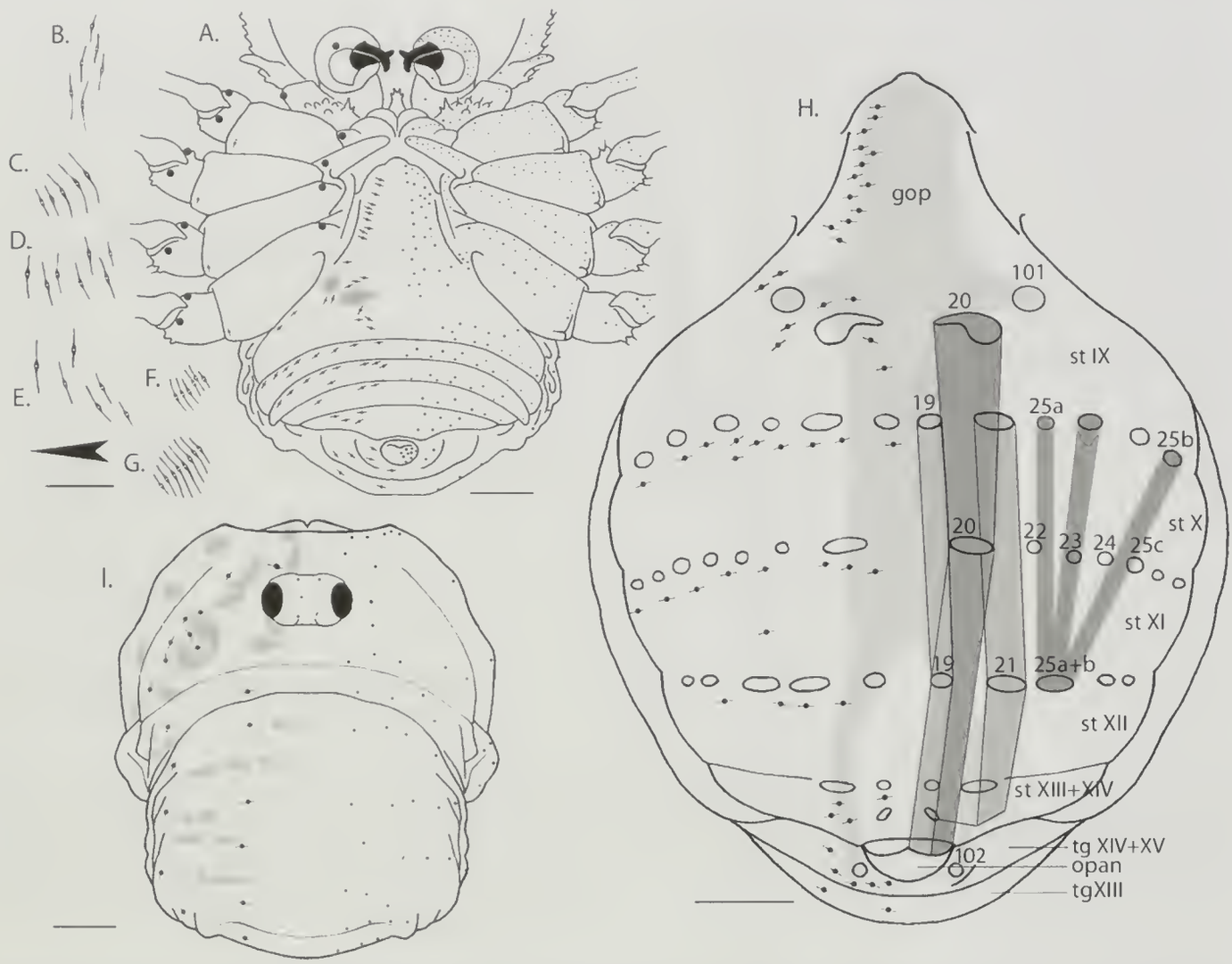


Fig. 13: Topography of sensory structures on body of *D. ramosus* (slits not drawn to scale). A. Male ventrum, chelicera, coxae and trochanters. Right side: sensilla chaetica (dots); left side: isolated slits (small black line with dot) and slit groups (large black dots). Grey spots correspond with insertion plaques of anterior extrinsic penial muscle (101) and lateral longitudinal muscle (20; see H); B-G. Slit groups (arrow indicates distal appendage direction) of: B. Coxapophysis leg I; C. Coxapophysis leg II; D. Coxa leg III; E. Coxa leg IV; F. Trochanter leg II anterior side; G. Trochanter leg II posterior side; H. Combined diagrammatic view of female genital operculum and ventrum with slit sensilla and muscle insertion plaques (numbers according to Shultz 2000). Left side: slit sensilla. Right side depicts dominant longitudinal muscle groups. Light grey area in the background indicates position of pregenital chamber and genital muscles with insertion plaques of anterior (101) and posterior extrinsic genital muscles (102). Abbreviations: gop = genital operculum, opan = anal operculum, st = sternite, tg = tergite; I. Male dorsum. Right side: sensilla chaetica (dots); left side: isolated slits and some muscle insertion plaques (grey shapes). Scale bars: A, H, I = 0.5 mm; B-G = 50 µm.

leg III was chosen to illustrate the basic topography of leg sensilla (Fig. 10). Both sexes have the following architecture. Spines occur in pairs on the dorsodistal margins of the femur, patella and tibia, ventrodistal margins of metatarsal pseudoarticulations and proximal tarsomeres of legs I, III and IV (Tab. 3), whereas leg II has no ventral spines (except for the distal metatarsomere, see below). Sensilla chaetica are distributed in large numbers on all leg segments, especially on the ventral sides of the tarsi. Trichomes are present from the patella to the tip. In the ventral region of the distal app. 20–25 tarsomeres trichomes form a dense brush.

Coxa – Coxapohysis of legs I and II, proximal region of coxae III and IV with slit group, a single slit near the posterolateral coxa-trochanter joint of all leg coxae (Figs. 10, 13a-e).

Trochanter – Two slit groups, a small one of 6 slits at the proventral articulating joint with the femur, and a larger one of 8 slits near the retrolateral articulation (Figs. 13f, g).

Femur – Proximally with four groups of campaniform sensilla. The dorsal, prolateral and retrolateral group are irregularly arranged, each consisting of 8 (occasionally 6 or 7) sensilla, the ventral group (Figs.

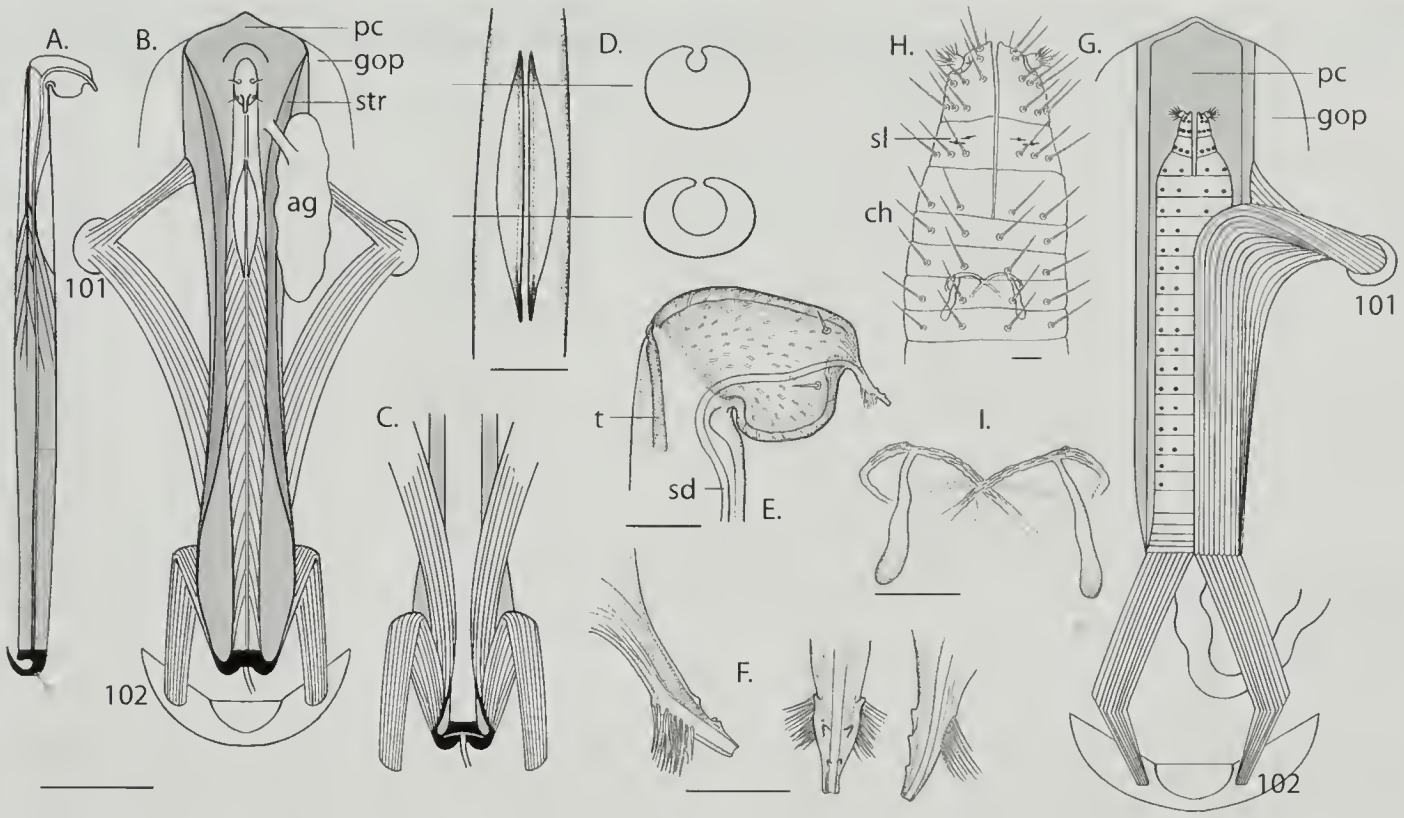


Fig. 14: Reproductive structures of *D. ramosus*. A-F: Male, G-I: Female. A. Diagrammatic lateral view of penis; B. Diagrammatic dorsal view of the genital apparatus with penial muscles and one accessory gland (propulsary organ and gonads omitted); C. Diagrammatic ventral view of the genital apparatus showing extrinsic penial muscles; D. Truncus slit and 2 cross sections; E. Lateral view of glans; F. Lateral and dorsal view of stylus; G. Diagrammatic dorsal view of ovipositor (black dots: sensilla chaetica), pregenial chamber and extrinsic genital muscles (gonads omitted); H. Distal part of ovipositor with sensilla chaetica and two pairs of slit sensilla; I. Seminal receptacles. Numbers indicate muscle insertion plaques (see Fig. 13). Abbreviations: ag = accessory gland, gop = genital operculum, pc = pregenital chamber, str = stiffening rod, sd = seminal duct, t = tendon of intrinsic penial muscle. Scale bars: A-C and G = 0.25 mm; D = 0.1 mm; E, H, I = 50 µm; F = 25 µm.

5b, 10a) consists of 10 campaniform sensilla placed in a 'V' or ')(' shape. All slits of the campaniform sensilla are oriented approximately perpendicular to the long axis of the leg. At the prolateral side of the dorsal femoral group 2 to 3 solenidia appear and occasionally 1 or 2 solenidia at the retrolateral side of the dorsal campaniform group. The femur has heavily sclerotised isolated large slits dorsally, perpendicular to the long axis, more or less evenly spaced: 3 in legs I, III and IV, 6 in leg II (Fig. 10b). One large slit is located at the distal retrolateral articulating joint with the patella. At the ventrodistal margin there is a single sensillum basiconicum.

Patella – Provided with trichomes, sensilla chaetica and two spines (Figs. 10a, b).

Tibia – Ventral proximal side with a group of 8 widely spaced campaniform sensilla (Fig. 10a). Two spines distally. At the ventrodistal margin a single sensillum basiconicum.

Metatarsus – Dorsal proximal region with 10 (occasionally 9) campaniform sensilla more or less in a row of five pairs. A few sensilla basiconica (2–5) and solenidia (2–6) dorsally. The dorsodistal metatarsal area has one or two sensilla basiconica and one to three solenidia. At the ventrodistal margin a single slit sensillum occurs and proximally of this slit a single bifid metatarsal spine is located (Figs. 10a, 11). The short shaft of the spine is always oriented anteriorly. It occurs in all legs in both sexes.

Tarsus – Large numbers of sensilla chaetica of different lengths on all sides of the tarsomeres. The ventral regions have concentrations of the short type, especially in legs I and II (Fig. 12). The numbers are given in Tab. 3 (for one male and one female all chaetica on the anterior sides of the leg tarsi were counted). The proximal segments have ventral pairs of spines (absent in leg II). Dorsally with solenidia, basiconica and falciform setae (Tab. 3). The sensilla are located at similar sites as in the pedipalp: falciform setae have a strict dorsal position, basiconica and solenidia generally are placed on the dorsolateral side. The majority of the solenidia are located in the

Tab. 3: Mean numbers, standard deviation and range of five sensory structures on the leg tarsi of *D. ramosus* (n = 10 males, 10 females; sensilla chaetica: n = 1 male, 1 female; prolateral side of tarsus). Also sensilla densities are given (in numbers per mm tarsus length). Numbers in bold represent significant differences (p<0.05).

		Male				Female				t-test
Sensillum type	Leg nr.	Mean	SD	Range (numbers)	Density [n/mm]	Mean	SD	Range (numbers)	Density [n/mm]	p
Falciform seta	I	13.1	2.13	11-18	1.5	14.2	0.87	13-16	1.9	0.14
	II	16.7	2.54	14-22	0.7	16.9	1.04	16-19	0.9	0.82
	III	7.8	1.48	6-11	0.8	8.2	0.79	7-9	1.1	0.46
	IV	6.4	1.51	4-9	0.5	6.5	1.08	5-8	0.6	0.89
Sensillum basiconicum	I	4.3	0.48	4-5	0.5	6.4	0.97	5-8	0.9	**<0.001**
	II	9.2	1.87	6-11	0.4	12.6	1.12	11-15	0.7	**<0.001**
	III	3.5	1.81	2-8	0.4	4.0	0.67	3-5	0.5	0.46
	IV	5.1	1.44	4-8	0.3	5.3	1.01	4-7	0.5	0.72
Sensillum chaeticum (n=1M, 1F)	I			385	44			279	38	
	II			712	31			592	31	
	III			305	31			246	33	
	IV			265	19			196	17	
Solenidium	I	31.2	2.35	29-37	3.6	37.0	3.27	30-40	5.1	**<0.001**
	II	51.8	4.21	47-59	2.2	50.6	3.38	47-58	2.7	0.49
	III	17.9	2.81	15-23	1.8	20.1	3.03	18-27	2.7	0.10
	IV	14.6	2.55	11-20	1.1	14.4	1.51	14-18	1.3	0.83
Spine (pairs)	I	14.1	3.14	9-18		13.7	2.15	11-18		0.75
	II	-	-	-		-	-	-		-
	III	20.7	1.68	19-24		20.3	1.25	18-22		0.51
	IV	30.5	2.64	26-34		27.4	2.07	23-30		**<0.01**

distal region of the tarsomeres, while the basiconica and falciform setae have a variable proximal/distal position (Figs. 12a, c).

Male legs – The species shows sexual dimorphism in lengths of the legs, in that all male legs are significantly (p<0.001) longer than the female legs (Tab. 2). Male leg III has large numbers of bipterate setae (an estimated 1000) on the metatarsus and proximal 14 to 18 tarsomeres. Bipterate setae are more or less evenly spaced on the prolateral to dorsal surface (Fig. 3c), while in more distal direction they tend to become confined to the dorsal side. Leg IV also has bipterate setae in the distal region of the metatarsus and proximal 8 to 10 tarsomeres (about 100 to 110 bipterate setae per leg). Tab. 3 provides the numbers of tarsal sensilla. The approximate densities of sensilla on the leg tarsi are given as numbers per mm. Tabs. 5 and 6 summarise results concerning sexual dimorphism.

Female legs – Distributions of sensory structures as in the male. Leg lengths (Tab. 2), numbers of tarsal sensilla and densities in Tab. 3. Bipterate setae are absent, instead only trichomes occur (Tab. 6).

Distribution of sensilla on ventrum and dorsum

The ventral side of the body is, in both sexes, provided with sensilla chaetica and slit sensilla (Fig. 13a). Slit groups are present on the pedipalpal trochanters (see Pedipalps; Figs. 8, 9), coxapophyses of legs I and II, proximal leg coxae III and IV and on all leg trochanters (see Legs; Figs. 13a, f, g). Close to the posterolateral coxa-trochanter joint of all legs an isolated slit occurs. Widely spaced, very small slits (15–20 µm) are located near the lateral margins of the genital operculum (11–15 slits per side). Additionally, in both sexes there are small isolated slits on all sternites (total numbers counted: 70 slits each in one female and in one male). A combined representation of sternal slit sensilla, muscles and insertion plaques of ventral muscle groups is presented in Fig. 13h (numeration of muscles and insertion plaques according to Shultz 2000).

The dorsal side of the body also has sensilla chaetica and slit sensilla (Fig. 13i). A pair of large slits is located in front of the eye tubercle, 7 or 8 small slits on both sides of the prosoma are associated with in-

Tab. 4: Mean numbers of slit and campaniform sensilla (arranged as occurring from proximally to distally on the appendage; slit groups in bold text, isolated slits in normal text) and total numbers for one male and one female (in parentheses the differing female numbers are given).

	Slit sensilla		Campaniform sensilla	
		Total		Total
Chelicera	**6-6**	24	-	-
Pedipalp	**4-5**-1	20	5-5-10 (5-5-15)	40 (50)
Leg I	**6**-1-**6**-**8**-4-1	52	10-8-8-8-8-10	104
Leg II	**5**-1-**6**-**8**-7-1	56	10-8-8-8-8-10	104
Leg III	**6**-1-**6**-**8**-4-1	52	10-8-8-8-8-10	104
Leg IV	**6**-1-**6**-**8**-4-1	52	10-8-8-8-8-10	104
Dorsum	60	60	-	-
Ventrum	94	94	-	-
Ovipositor	- (**2-2**)	- (8)	-	-
Total male (female)		410 (418)		456 (466)

sertion plaques of the prosomal muscle groups. Tergites VI to XIII have 4 slits, and tergite XIV+XV has about 10 slits associated with the insertion plaques of the posterior extrinsic genital muscles (Figs. 13a, h). A total number of 58 to 60 dorsal slit sensilla was found (n = 2 males, 1 female). Numbers and topography are similar in males and females (Tab. 4).

Reproductive structures

The male and female reproductive organs are homologous structures, located under the genital operculum. These have a characteristic phalangioid morphology (Macías-Ordóñez et al. 2010, Martens et al. 1981). The male genital apparatus (Figs. 14 a-f) comprises a tubular, sclerotized penis and membranous hematodocha, with a dorsoventral pair of large stiffening rods. The penis is long and slender with a large intrinsic penial muscle approximately in the basal 4/5 part of the truncus (Fig. 14a). Its single central tendon terminates at the ventral base of the glans and functions in flexing the glans by approximately 90° against the shaft so that in a flexed position the glans is orientated parallel to the shaft in a distal prolongation (Fig. 14e). Particularly the base of the truncus is heavily sclerotised (Figs. 14b, c) and bears two dorsally curved lateral projections as attachment sites for both the posterior and anterior pairs of extrinsic penial muscles (101 and 102 in Fig. 14b). In resting position the posterior extrinsic muscles pass ventrally of the pregenital chamber, are folded and attach to tergites XIV+XV, at both sides of the anal operculum. Dorsodistally the truncus is provided with an oval shaped internal cavity, opening to the exterior via a large median slit, which is also confirmed by cross sections (Fig. 14d). The proximal and distal slit areas are sclerotised. A pair of accessory glands is present with ducts connected to the sheath of the pregenital chamber (Fig. 14b). The glans bears two pairs of sensilla chaetica, its stylus is provided ventrally with a brush of setae and dorsally with two or three pairs of minute denticles (Figs. 14e, f). The sensilla chaetica as well as the brush setae appear to be innervated, indicating that the brush may also have a sensory function.

The female reproductive apparatus consists of an inner and outer sheath enclosing an ovipositor, which is a dorsoventrally flattened cylinder composed of 25 to 27 cuticular annulations, terminating in a bifurcate tip consisting of three apical rings (Figs. 14g, h). At the furca base the vagina marks the distal end of the uterus internus. The proximal ovipositor segments 7 and 8 have two pairs of sensilla chaetica, followed by 14 to 16 segments with four pairs, while the distal furca segments have 4, 6 and 16 sensilla chaetica on each side respectively. On the distal segment a rounded projection is situated, provided with a tuft of sensory setae (Fig. 14h), probably deriving from a single sensillum chaeticum (Martens et al. 1981). The second rings have two pairs of two slit sensilla on the dorsal, and two pairs on the ventral side. At the level of the distal 5th to 7th ovipositor segments the seminal receptacles are located (Figs. 14h, i).

The base of the pregenital chamber is provided with a pair of posterior extrinsic genital muscles at-

Tab. 5: Average totals of sensilla basiconica, falciform setae, solenidia and spines for one male and one female.

	Basiconica		Falciform setae		Solenidia		Spines	
	Male	Female	Male	Female	Male	Female	Male	Female
Pedipalp	13	13	10	13	43	44	2	2
Leg I	8	10	13	14	40	46	44	46
Leg II	15	19	17	17	62	61	8	8
Leg III	8	8	8	8	25	26	56	54
Leg IV	9	9	6	7	22	21	80	74
Totals for one animal	106	118	108	118	384	396	380	368

taching to tergites XIV+XV. Another pair of muscles derives from the base of the pregenital chamber, enclosing the outer sheath dorsally and ventrally as a single sheet of muscle fibres and then joining with the muscles of the anterior genital muscle that attaches to the lateral plaques of sternite VIII (Fig. 14g).

Conclusions and discussion

Much work has been done on the basic morphology, distribution and ultrastructure of sensory structures in several arachnid groups, such as Ricinulei (Talarico et al. 2006, 2008) and Acari (Coons & Alberti 1999). For Opiliones only a limited number of studies have been published on this matter. Since the ultrastructure of campaniform sensilla, falciform setae, sensilla basiconica, solenidia and bipterate setae has not been examined in Opiliones so far, their functional properties have not been established. Willemart & Giribet (2010) proved that the shaft of solenidia has a multipored nature, indicating that they are olfactory sensilla (reviewed in Willemart et al. 2009). They show similarities to 'Type 6' sensilla in Ricinulei (Talarico et al. 2006). At least some sensilla chaetica have a terminal pore (Willemart & Gnaspini 2003) which would fit the view that these sensilla chaetica are contact chemoreceptors or have a dual function (contact chemoreception and mechanoreception) (Guffey et al. 2000, Kauri 1989, Spicer 1987, Willemart & Gnaspini 2003, Willemart et al. 2009). It appears that trichomes are non-sensory hairs for which several functions have been proposed: they may protect the integument as well as other sensilla and act as a brush to clean the body (Willemart & Gnaspini 2003, Willemart et al. 2009).

The best studied sensory type is the slit sensillum (Barth & Stagl 1976, Barth 2002, 2004, Blickhan & Barth 1985, Kropf 1998, Luque 1993, Talarico et al. 2006, 2008). Slit sense organs are known to be detectors of mechanical stresses in the cuticle caused by muscular activity and/or haemolymph pressure (proprioception), or of strains imposed by external pressure (exteroception; Barth 2004, Shultz & Pinto-da-Rocha 2007). In *D. ramosus*, for example, the single slit sensillum close to the tip of the pedipalpal

Tab. 6: Summary of sexual dimorphism in *D. ramosus* (differences in colouration not included).

	Male	Female
Opisthosoma	Small, flattened dorsally	Large, with dorsal protuberance
Pedipalp	Length 6.5 mm; Femur, patella and tibia no plumose setae; Patellal apophysis slender with more pointed tip, covered with sensilla chaetica only; Tarsus with ~10.2 campaniform sensilla; Tarsus with ~9.6 falciform setae	Length 6.8 mm; Femur, patella and tibia with plumose setae; Patellal apophysis stout with more rounded tip, covered with plumose setae only; Tarsus with ~15.4 campaniform sensilla; Tarsus with ~12.5 falciform setae
Legs	Longer (Tab. 2); Tarsus I with ~31.2 solenidia; Tarsus I with ~4.3, tarsus II with ~9.2 basiconica; Leg III and IV with bipterate setae; Tarsus IV with ~30.5 pairs of spines	Shorter (Tab. 2); Tarsus I with ~37.0 solenidia; Tarsus I with ~6.4, tarsus II with ~12.6 basiconica; Leg III and IV without bipterate setae; Tarsus IV with ~27.4 pairs of spines

tarsus (Fig. 7a) probably senses torsion forces caused by the use of the pedipalpal claw. This is very similar in Ricinulei (Talarico et al. 2008).

The ventral side of the body has a higher density of slits than the dorsal side (Tab. 4; sternites plus genital operculum app. 94 slits, carapace plus tergites app. 60 slits; compare Figs. 13a, h, i) which is most likely related to the ventral presence of reproductive organs. The occurrence of sternal slit sensilla (Fig. 13h) clearly coincides with insertion plaques of various muscle groups that are involved in everting/inverting the penis/ovipositor: the extrinsic genital muscles directly operate the genital tract, whereas the lateral longitudinal muscles regulate opisthosomal volume and haemocoelic pressure (Barth 2004, Martens et al. 1981, Shultz 2000). Consequently, the slits on the genital operculum and ventrum probably function as detectors of cuticle deformations once the genital operculum is opened and the penis or ovipositor is extruding. Thus, for both sexes they may play an essential proprioceptive sensory role during courtship and mating activities. In addition, for the female these slits may be functional during egg deposition.

The slit sensilla on the lateral margins of the dorsal prosoma occur associated with muscle insertion plaques that are involved in movements of the leg coxae (Fig. 13i; pedal tergocoxal muscles no. 65 to 69 in Shultz 2000). I traced only one publication relating to slit sensilla and muscle insertion plaques. Referring to single slits in spiders, Barth (2002, p. 41) mentioned that "some of them lie conspicuously close to the sites of muscle attachment".

Although no histological studies on campaniform sensilla have been conducted so far, most authors regard them as homologous to slit sensilla, detecting mechanical stresses in the cuticle (Edgar 1963, Barth & Stagl 1976); a view which is supported by this study. In *D. ramosus* they appear in four groups on the proximal leg femora, exactly at sites where in *Amilenus aurantiacus* (Simon, 1881) (Phalangiidae) slit groups are located (Barth & Stagl 1976). Also, their orientations relative to each other and – generally – perpendicular to the long axis of the appendages are similar. Some of these similarities have previously been pointed out by Barth & Stagl (1976). Moreover, on the leg metatarsi groups are composed of typical campaniform sensilla together with slit-like types and intermediary shapes not clearly attributable to either category, as was also recorded by Edgar (1963). Campaniform sensilla may be characterised as 'compact slits'.

The row of campaniform sensilla laterally on the pedipalpal tarsus (Figs. 8e, 9f) may communicate to the animal how much mechanical resistance is offered by a particular surface the harvestman is probing, e.g. the hardness/softness of a potential food item. The larger numbers on the female pedipalpal tarsus (Tab. 1: male 10.2, female 15.4 campaniform sensilla) may play a role in selecting suitable egg deposition sites.

When dealing with 'proprioceptive organs' in Opiliones, slit and campaniform sensilla may deserve identical treatment. In a comparative study on slit sensilla in the legs of Chelicerata, Barth & Stagl (1976) excluded campaniform sensilla distal to the femur of *Amilenus aurantiacus*, and consequently made mention of only 45 slits for leg I. In *D. ramosus* an average of 52 slits and 104 campaniform sensilla were recorded for leg I (Tab. 4), which results in a considerably larger total of 156 'proprioceptive' sensilla on leg I. Total numbers for one male are 866 (410 slits + 456 campaniform sensilla); for one female 884 (418 slits + 466 campaniform sensilla), of which 628 (73% and 71% respectively) are located in the legs.

The legs in *D. ramosus* – and Eupnoi in general – easily break off at the appendotomy plane, at the trochanter-femur junction. A leg can be actively detached to escape from a predator, or in case it is trapped during moulting (Edgar 1963). As these legs are not regenerated, it is common to encounter harvestmen in the field with one or more legs missing. In *D. ramosus* all legs have a similar basic set of sensory structures like sensilla chaetica, solenidia, falciform setae and sensilla basiconica. So, the loss of one or more legs does not fundamentally affect the sensory capabilities.

The highest numbers occur on the first and second legs, indicating that these legs have an important sensory function (Tab. 3). Compared to legs III and IV, legs I and II have larger numbers of sensilla chaetica in the ventral region of the tarsi (Fig. 12, Tab. 3), which may be associated with a more accurate perception of the physical characteristics of the environment like size, form and texture (Willemart & Gnaspini 2003).

Judged only from the numbers of solenidia (male app. 52, female 51), leg II is the most important sensory organ, but considering its extreme length, its

tarsus has a rather low density of solenidia per mm (male app. 2.2, female 2.7), whereas the tarsus of leg I (male app. 31, female 37 solenidia) is much shorter, resulting in a density of 3.6 and 5.1 solenidia per mm, respectively. This also applies for basiconica and falciform setae. With leg II the animal can obtain 'general features' of its wider surroundings, whereas leg I is more appropriate for gathering detailed information at closer range. This strongly supports the recent point of view to reconsider the general denomination of 'sensory appendages' for legs II in Opiliones (Willemart & Gnaspini 2003, Willemart & Chelini 2007, Willemart et al. 2009).

The absence of spines on the tarsomeres of leg II may facilitate grooming of these appendages, thus cleaning the sensory organs, in cooperation with the chelicerae, pedipalps and mouth; a behaviour that is often seen in this species. Spines occur on the proximal tarsomeres of legs I, III and IV, lacking in the distal regions (Fig. 10) which are often observed to be tightly wrapped around grasses or other objects to anchor themselves to a substrate (Guffey et al. 2000).

The pedipalps are loaded with densely arranged sensilla (up to 34 solenidia on the tarsus measuring about 1.8 mm) with higher densities towards the tarsal tip (Figs. 7a, b) and they are therefore very important sensory organs. The distribution of sensilla shows remarkable similarities with the pedipalp of Ricinulei (Talarico et al. 2008: Fig. 5). In *D. ramosus* the contact mechano- and chemoreceptors (sensilla chaetica) are scattered over the whole surface for optimum exposure to all surfaces the animal explores by touch. But the solenidia and sensilla basiconica occur only in the dorsal to dorsolateral region, away from potentially contaminating substrata (like sticky food items or moist substrates), and protected from direct contact by a cover of trichomes (Fig. 7c). These sensilla may work once a substratum is actively touched with the dorsal region of the pedipalpal tarsus, a behaviour that is often seen in the field (e.g. Fig. 1). Willemart & Hebets (2012) recorded this 'pedipalp tapping' (a behaviour wherein the tip and the dorsal region of the tarsi gently touch the substrate) in *Leiobunum vittatum* (Say, 1821) (Sclerosomatidae). They found that both males and females react by pedipalp tapping to chemical cues left on a substrate by conspecifics. This suggests that besides sensilla chaetica one or more of the other sensilla types (e.g. basiconica, falciform setae or the basiconica 'trident') on the dorsal pedipalpal region may have a chemoreceptive function.

Interestingly, in some cases two different sensory structures occur 'clustered': a slit group with a group of solenidia on the pedipalpal femur (Figs. 8c, j, 9c), a bifid metatarsal spine associated with a single slit sensillum in the legs (Fig. 11), solenidia and campaniform sensilla proximally on the leg femora (Fig. 10). Whether these sensilla combinations represent specialised functions remains to be studied.

In general, the results show a remarkable similarity between males and females in the topography and number of examined sensilla (Tabs. 4, 5, 6). The pedipalpal tarsus, for example, has not revealed any significant macro- or microsculptural sexual disparity, except for the larger numbers of tarsal campaniform sensilla and falciform setae in the female.

Both sexes have equivalent numbers of leg sensilla (Tab. 3), but the female has more basiconica in legs I and II, and more solenidia in legs I. The male leg IV has slightly more spines. However, since the female's legs are much shorter this results in higher densities of sensilla for the female. This is most distinct for basiconica densities in legs I and II and for solenidia densities in leg I.

A very evident result concerning sexual dimorphism in *D. ramosus* is the female pedipalp which is covered with hundreds of plumose glandular setae, absent in the male, whereas the male has hundreds of bipterate setae on legs III and IV, absent in the female. Until now bipterate setae had been found only in *Phalangium opilio* (Willemart et al. 2009). For comparison, I investigated some specimens of *P. opilio* and found bipterate setae on the male legs III and IV, with very similar morphology, topography and densities as in *D. ramosus*. I failed to find them in legs I and II. It should be mentioned here that the SEM micrographs in Willemart et al. (2009: Figs. 9, 10, 11) show distorted bipterate setae, with winged portions twisted, not representing their natural arrangements as seen with light microscopy. This is likely a result of procedures for scanning electron microscope preparations.

The morphology of bipterate setae suggests that they are olfactory sensilla. Both wings of each seta are concavely shaped, and their striae are directed towards the proximal junction, possibly 'guiding' odour molecules to the micropore. Their arrangement on the dorsal and anterodorsal leg surfaces provides optimum exposure to the atmosphere, and thus, to

odorant stimuli that arrive at the animal's legs from ahead. As this character is sexually dimorphic, the function of bipterate setae may be to detect a female from a distance and direct him towards her. Non-tactile perception of volatile secretions has been demonstrated in Goniosomatinae (Gonyleptidae) (Machado et al. 2002). A cotton swab with exocrine gland secretions of the same species held at a distance of 1–2 cm from an aggregation elicited an alarm response. Whether the volatile secretions receptive to the male of *D. ramosus* are produced by the glandular plumose setae of the female remains to be tested.

Acknowledgments

I wish to thank Jörg Pageler (Oldenburg, Germany) for his beautiful picture of *D. ramosus*. Walter Pfliegler (Debrecen, Hungary) prepared many dozens of excellent microscopic photos of most sensilla types for which I am very thankful. Paul Kouwer (Malden, Netherlands) kindly provided advice on statistics. I also want to thank Jochen Martens (Mainz, Germany), Rogelio Macias-Ordonez (Xalapa, Mexico) and Axel Schönhofer (Mainz, Germany). The manuscript was improved by comments from three anonymous reviewers.

References

Barth FG & Stagl J 1976 The slit sense organs of arachnids: a comparative study of their topography on the walking legs (Chelicerata, Arachnida). – Zoomorphologie 86: 1-23 – doi: 10.1007/BF01006710

Barth FG 2002 A spider's world: senses and behavior. Springer, Berlin. 394 pp. – doi: 10.1007/978-3-662-04899-3

Barth FG 2004 Spider mechanoreceptors. – Current Opinion in Neurobiology 14: 415-422 – doi: 10.1016/j.conb.2004.07.005

Cawley M 1995 *Dicranopalpus ramosus* (Simon) (Arachnida: Opiliones), new to Ireland. – Irish Naturalist's Journal 25: 153

Blickhan R & Barth FG 1985 Strains in the exoskeleton of spiders. – Journal of Comparative Physiology A 157: 115-147 – doi: 10.1007/BF00611101

Cokendolpher JC & Lee VF 1993 Catalogue of the Cyphopalpatores and bibliography of the harvestmen (Arachnida, Opiliones) of Greenland, Canada, USA and Mexico. Vintage Press, Lubbock/Texas. 82 pp.

Coons LB & Alberti G 1999 Acari: Ticks. In: Harrison FW & Foelix RF (Ed) Microscopic anatomy of Invertebrates. Volume 8B: Chelicerate Arthropoda. Wiley Liss, New York. pp. 438-466.

Crawford RL 1992 Catalogue of the genera and type species of the harvestman superfamily Phalangioidea (Arachnida). – Burke Museum Contributions in Anthropology and Natural History 8: 1-60

Cuppen JGM 1994 *Dicranopalpus ramosus*, a new species of harvestman for the Netherlands (Opilionida: Phalangiidae). – Entomologische Berichten 54: 176-178

Edgar AL 1963 Proprioception in the legs of phalangids. – Biological Bulletin 124: 262-267 – doi: 10.2307/1539475

Giribet G, Edgecombe GD, Wheeler WC & Babbitt C 2002 Phylogeny and systematic position of Opiliones: a combined analysis of chelicerate relationships using morphological and molecular data. – Cladistics 18: 5-70 – doi: 10.1111/j.1096-0031.2002.tb00140.x

Goodnight MR & Goodnight CJ 1976 Observations on the systematics, development and habits of *Erginulus clavotibialis* (Opiliones, Cosmetidae). – Transactions of the American Microscopical Society 95: 654-664

Guffey C, Townsend VR Jr & Felgenhauer BE 2000 External morphology and ultrastructure of the prehensile region of the legs of *Leiobunum nigripes* (Arachnida, Opiliones). – The Journal of Arachnology 28: 231-236 – doi: 10.1636/0161-8202(2000)028[0231:EMAUOT]2.0.CO;2

Hedin M, Tsurusaki N, Macías-Ordóñez R & Shultz JW 2012 Molecular systematics of sclerosomatid harvestmen (Opiliones, Phalangioidea, Sclerosomatidae): Geography is better than taxonomy in predicting phylogeny. – Molecular Phylogenetics and Evolution 62: 224-236 – doi: 10.1016/j.ympev.2011.09.017

Hillyard PD & Sankey JHP 1989 Harvestmen. Synopses of the British Fauna, new series. Linnean Society of London 4. 119 pp.

Hillyard P 2000 (red.) *Dicranopalpus ramosus*. – Ocularium, Newsletter of the Opiliones Recording Scheme 3: 2

Kauri H 1989 External ultrastructure of sensory organs in the subfamily Irumuinae (Arachnida, Opiliones, Assamiidae). – Zoologica Scripta 18: 289-294 – doi: 10.1111/j.1463-6409.1989.tb00454.x

Kropf C 1998 Slit sense organs of *Comaroma simonii* Bertkau: a morphological atlas (Araneae, Anapidae). In: Selden PA (Ed) Proceedings of the 17th European Colloquium of Arachnology, Edinburgh 1997. pp. 151-159

Luque CG 1993 The slit sense organs. Contribution to the knowledge of species *Sabacon pasonianum* Luque, 1991 (Opiliones: Palpatores: Sabaconidae). – Mémoires de Biospéologie 20: 131-137

Machado G, Bonato V & Oliveira PS 2002 Alarm communication: a new function for the scent-gland secretion in harvestmen (Arachnida: Opiliones). – Naturwissenschaften 89: 357-360 – doi: 10.1007/s00114-002-0337-8

Machado G & Macías-Ordóñez R 2007 Reproduction. In: Pinto-da-Rocha R, Machado G & Giribet G (Eds) Harvestmen: The biology of Opiliones. Harvard University Press, Cambridge/Massachusetts. pp. 14-61

Macías-Ordóñez R, Machado G, Pérez-González A & Shultz JW 2010 Genitalic evolution in Opiliones. In: Leonard JL & Córdoba-Aguilar A (Eds) The evolution of primary sexual characters in animals. Oxford University Press, New York. pp. 285-306

Martens J 1978 Spinnentiere, Arachnida – Weberknechte, Opiliones. – Die Tierwelt Deutschlands 64: 1-464

Martens J, Hoheisel U & Götze M 1981 Vergleichende Anatomie der Legeröhren der Opiliones als Beitrag zur Phylogenie der Ordnung (Arachnida). [Comparative anatomy of the ovipositors of the Opiliones as a contribution to the phylogeny of the order (Arachnida).] – Zoologische Jahrbücher, Abteilung für Anatomie und Ontogenie der Tiere 105: 13-76

Noordijk J, Wijnhoven H & Cuppen JGM 2007 The distribution of the invasive harvestman *Dicranopalpus ramosus* in the Netherlands (Arachnida: Opiliones). – Nederlandse Faunistische Mededelingen 26: 65-68

Pinto-da-Rocha R & Giribet G 2007 Taxonomy. In: Pinto-da-Rocha R, Machado G & Giribet G (Eds) Harvestmen: The biology of Opiliones. Harvard University Press, Cambridge/Massachusetts. pp. 88-246

Sankey JHP & Storey MW 1969 *Dicranopalpus caudatus* Dresco (Arachnida: Opiliones), first record in Britain and France. – Entomologists' Monthly Magazine 105: 106-107

Schmidt C 2004 Der Weberknecht *Dicranopalpus ramosus* (Simon, 1909) (Arachnida, Opiliones, Phalangiidae) neu für Deutschland. – Mitteilungen der Arbeitsgemeinschaft der Westfälischen Entomologen 20: 1-12

Shultz JW 2000 Skeletomuscular anatomy of the harvestman *Leiobunum aldrichi* (Weed, 1893) (Arachnida: Opiliones: Palpatores) and its evolutionary significance. – Zoological Journal of the Linnean Society 128: 401-438 – doi: 10.1006/zjls.1999.0186

Shultz JW & Pinto-da-Rocha R 2007 Morphology and functional anatomy. In: Pinto-da-Rocha R, Machado G & Giribet G (Eds) Harvestmen: The biology of Opiliones. Harvard University Press, Cambridge/Massachusetts. pp. 14-61

Slosse W 1995 *Dicranopalpus ramosus* (Opiliones, Phalangiidae), nieuw voor de Belgische fauna. – Nieuwsbrief van de Belgische Arachnologische Vereniging 10: 11-13

Spicer GS 1987 Scanning electron microscopy of the palp sense organs of the harvestman *Leiobunum townsendi* (Arachnida: Opiliones). – Transaction of the American Microscopical Society 106: 232-239

Talarico G, Palacios-Vargas JG, Fuentes Silva M & Alberti G 2006 Ultrastructure of tarsal sensilla and other integument structures of two *Pseudocellus* species (Ricinulei, Arachnida). – Journal of Morphology 267: 441-463 – doi: 10.1002/jmor.10415

Talarico G, Palacios-Vargas JG & Alberti G 2008 The pedipalp of *Pseudocellus pearsei* (Ricinulei, Arachnida) – ultrastructure of a multifunctional organ. – Arthropod Structure & Development 37: 511-521 – doi: 10.1016/j.asd.2008.02.001

Toft S & Hansen MDD 2011 Gaffelmejerens *Dicranopalpus ramosus* lyninvasion i Danmark. [High-speed invasion of Denmark by the harvestman *Dicranopalpus ramosus*.] – Flora og Fauna 117(1): 47-51

Willemart RH & Chelini M C 2007 Experimental demonstration of close-range olfaction and contact chemoreception in the Brazilian harvestman, *Iporangaia pustulosa*. – Entomologia Experimentalis et Applicata 123: 73-79 – doi: 10.1111/j.1570-7458.2007.00527.x

Willemart RH, Farine J-P & Gnaspini P 2009 Sensory biology of Phalangida harvestmen (Arachnida, Opiliones): a review, with new morphological data on 18 species. – Acta Zoologica 90: 209-227 – doi: 10.1111/j.1463-6395.2008.00341.x

Willemart RH, Farine J-P, Peretti AV & Gnaspini P 2006 Behavioral roles of sexually dimorphic structures in the harvestman, *Phalangium opilio* (Opiliones, Phalangiidae). – Canadian Journal of Zoology 84: 1763-1774 – doi: 10.1139/z06-173

Willemart RH & Giribet G 2010 A scanning electron microscopic survey of the cuticle in Cyphophthalmi (Arachnida, Opiliones) with the description of novel sensory and glandular structures. – Zoomorphology 129: 175-183 – doi: 10.1007/s00435-010-0110-z

Willemart RH & Gnaspini P 2003 Comparative density of hair sensilla on the legs of cavernicolous and epigean harvestmen (Arachnida: Opiliones). – Zoologischer Anzeiger 242: 353-365 – doi: 10.1078/0044-5231-00109

Willemart RH & Hebets EA 2012 Sexual differences in the behavior of the harvestman *Leiobunum vittatum* (Opiliones, Sclerosomatidae) towards conspecific cues. – Journal of Insect Behavior 25: 12-23 – doi: 10.1007/s10905-011-9268-6

The whip spider collection (Arachnida, Amblypygi) held in the Natural History Museum Vienna, Austria

Michael Seiter & Christoph Hörweg

doi: 10.5431/aramit4606

Abstract. We present data and remarks on the history and contents of the whip spider collection housed in the Natural History Museum of Vienna, Austria. The collection comprises a total of 167 specimens from 4 families, 10 genera and 27 species. It includes types of four species: *Charinus ioanniticus* (Kritscher, 1959), *Damon brachialis* Weygoldt, 1999, *Phrynus parvulus* (Pocock, 1902) and *Paraphrynus mexicanus* (Bilimek, 1867). Short notes on interesting objects and former curators are provided as well as an appendix with a list of species kept alive by Michael Seiter.

Keywords: museum's collection history, NHMW, Reimoser, small arachnid order

Zusammenfassung. Die Geißelspinnensammlung (Arachnida, Amblypygi) des Naturhistorischen Museums Wien, Österreich. Wir präsentieren Daten und Anmerkungen zur Geschichte und dem Inhalt der Geißelspinnen-Sammlung des Naturhistorischen Museums Wien, Österreich. Die Sammlung umfasst 167 Individuen aus 4 Familien, 10 Gattungen und 27 Arten und beinhaltet Typen von vier Arten: *Charinus ioanniticus* (Kritscher, 1959), *Damon brachialis* Weygoldt, 1999, *Phrynus parvulus* (Pocock, 1902) and *Paraphrynus mexicanus* (Bilimek, 1867). Die Angaben werden durch kurze Anmerkungen zu interessanten Objekten und früheren Kuratoren sowie einem Appendix mit der Liste der von Michael Seiter lebend gehaltenen Arten ergänzt.

Amblypygi, or so-called whip spiders, (order Arachnida) are tropical to subtropical organisms with special morphological traits among the arachnids. They are characterised by their dorso-ventrally flattened body and strong, raptorial pedipalps armed with spines. The first legs are extremely elongated and antenniform. These legs are very important during mating, hunting and antagonistic behaviour (Weygoldt 2000). According to Prendini (2011) recent Amblypygi currently include 5 families, 17 genera and 161 species; however Blick & Harvey (2011) mentioned 171 species, Seiter (2011) tallied 174 species and Harvey (2013) listed 186 species.

Worldwide, only a few scientists have recently worked regularly on whip spiders (e.g. Weygoldt 2000, 2002, Harvey 2003, 2007). Some studies focused on parthenogenesis (de Armas 2000, 2005, Weygoldt 2007), others compiled revisions of particular groups (Kraepelin 1895, Mullinex 1975, Garcia Acosta 1977, Quintero 1981, Weygoldt 1999, Rahmadi et al. 2011). In recent years the need for taxonomic data has increased because scientists have described numerous new species (Harvey & West 1998, de Armas & Teruel 2010, Rahmadi et al. 2010, 2011, de Armas 2012, Giupponi & Miranda 2012). For this reason it is necessary to know where the type material, and other specimens needed for comparison, are located. For the first time, precise data are here made available for the whip spiders in the collection of the Natural History Museum Vienna (NHMW).

Michael SEITER, Group of Arthropod Ecology and Behavior, Division of Plant Protection, Department of Crop Sciences, University of Natural Resources and Life Sciences, Peter Jordan-Strasse 82, 1190 Vienna, Austria. E-Mail: michael.seiter@boku.ac.at
Christoph HÖRWEG, Natural History Museum Vienna, 3. Zoology (Invertebrates), Burgring 7, A-1010 Vienna, Austria. E-Mail: christoph.hoerweg@nhm-wien.ac.at

submitted 16.11.2011, accepted 29.10.2013, online 9.11.2013

Material and methods

The collection of Amblypygi (Arachnida) in the Natural History Museum Vienna (NHMW) was revised between April and June 2011. Acquisition (Fig. 1) and inventory books, as well as datasheets, were screened. A stereomicroscope (Wild/Leica M3Z) was used to investigate the specimens and photos were made with a Nikon DSII camera. The identity of specimens was verified in some cases and labels – if necessary – renewed. The labels usually include the name of the species, the date of collection and the location. Furthermore, the name of the collector and/or donator, the name of the person who determined the specimen (sometimes also the date of determination), the acquisition number and the inventory number are given (see Fig. 2). In many cases the sex had not been determined. This lack of information was tolerated to protect the structures of the genital operculum and surround-

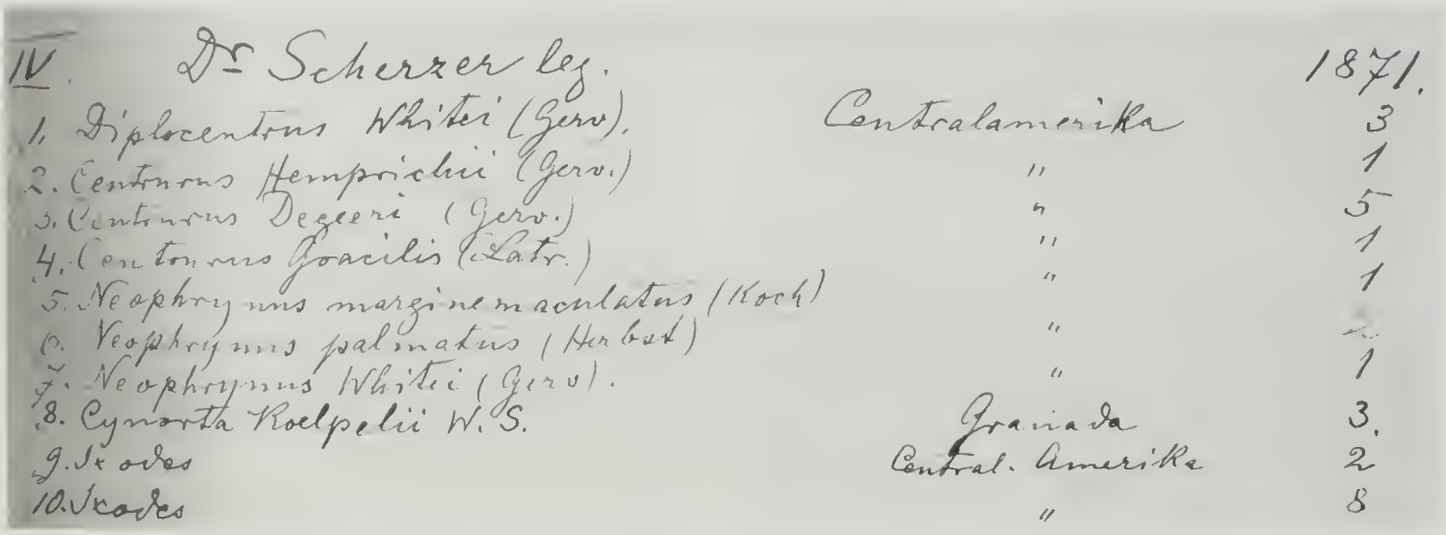

IV. Dr Scherzer leg. 1871.
1. Diplocentrus Whitei (Gerv.). Centralamerika 3
2. Centrurus Hemprichii (Gerv.) " 1
3. Centrurus Degeeri (Gerv.) " 5
4. Centrurus Gracilis (Latr.) " 1
5. Neophrynus marginemaculatus (Koch) " 1
6. Neophrynus palmatus (Herbst) " [illegible]
7. Neophrynus Whitei (Gerv.). " 1
8. Cynorta Koelpelii W.S. Granada 3.
9. Scorpiones Central. Amerika 2
10. Scorpiones " 8

Fig. 1: Extract from the acquisition book with the record (1871.IV) of the oldest amblypygi. Numbers 5–7: *Neophrynus* spp. from "Central America". *Neophrynus marginemaculatus* has been transferred to *Phrynus marginemaculatus* C.L. Koch, 1840; *Neophrynus palmatus* has been transferred to *Phrynus barbadensis* (Pocock, 1894); *Neophrynus whitei* has been transferred to *Phrynus asperatipes* Wood, 1863.

ing areas. Most of the material is in good condition and can be used for scientific studies. All specimens, with a few exceptions that have been conserved dry, are stored in 70 % ethanol (denatured). Some material might have been influenced by formalin at an earlier date, but no detailed information is available about this. Nomenclature follows Harvey (2003, 2013), since these works include the last complete listings.

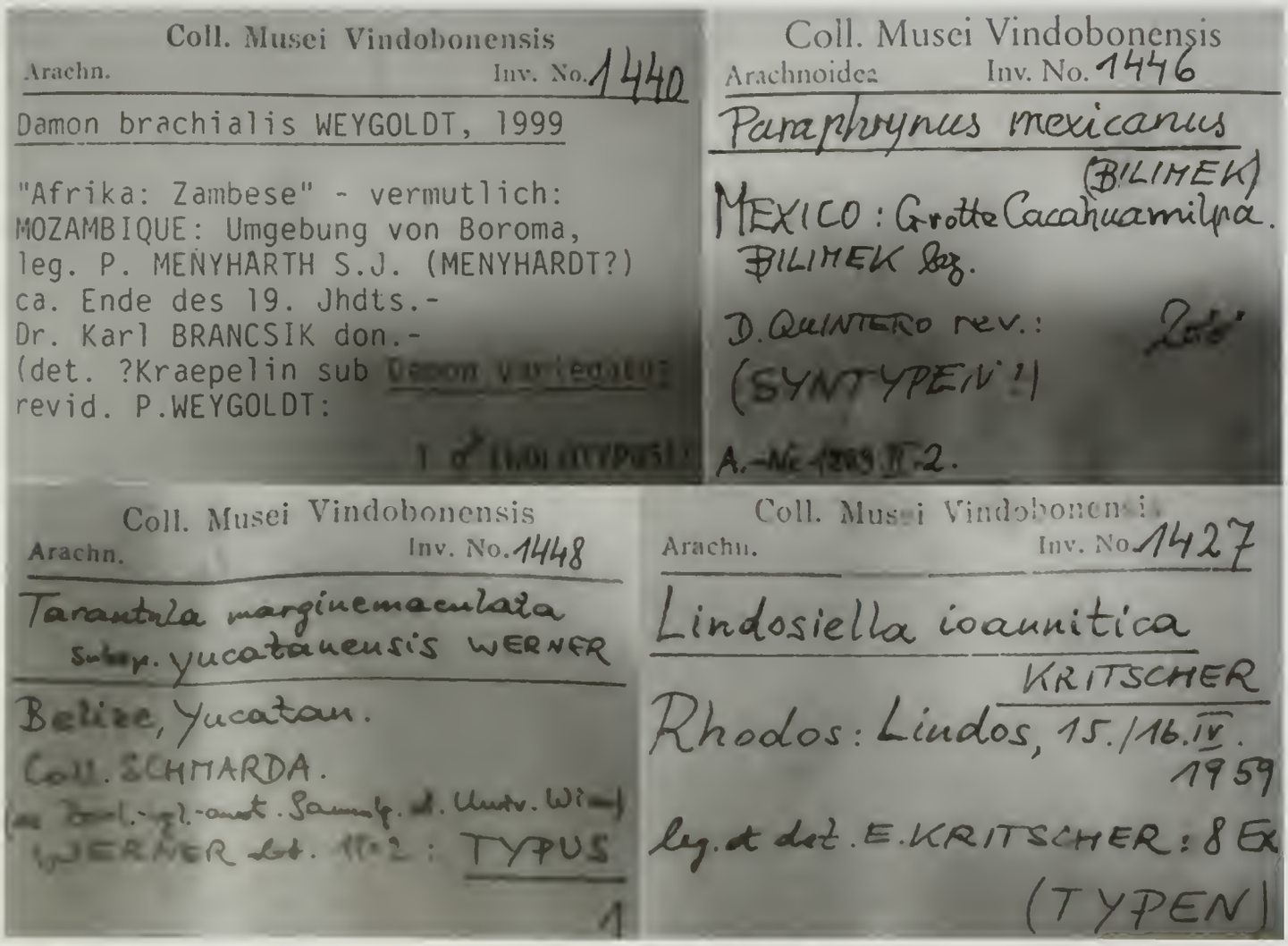


Fig. 2: Typical labels in the collection of arachnids at the NHMW using the labels of the four type specimens of Amblypygi.

Fig. 3: Female of *Charinus ioanniticus* (Rhodes, found in subterranean passages of the ancient city of Rhodes and photographed alive in a standard plastic terrarium by M. Seiter)

List of abbreviations: BMNH: British Museum (Natural History) in London, NHMW: Natural History Museum Vienna, sp.: species, leg. = legit (collected), det. = determinavit (determined), don. = (donated), ♂ = male / ♀ = female, ♂♂ = males / ♀♀ = females, HT = Holotype, LT = Lectotype, ST = Syntype

Results

The oldest parts of the Arachnoidea collection itself may date back to the early 19th century; the oldest Amblypygi dates from 1871 (see Fig. 1). The curators responsible for the collection of arachnids, starting in 1878, were Carl Koelbel, Theodor Adensamer, Arnold Penther, Carl Attems, Otto Pesta, Eduard Reimoser, Hans Strouhal, Gerhard Pretzmann, Jürgen Gruber, Verena Stagl (for the collection history see Pesta 1940) and, today, the second author of this paper: Christoph Hörweg.

For whip spiders, relevant collectors/donators in former times were Theodor Adensamer, Dominik Bilimek and Eduard Reimoser (see Pesta 1940), and more recently Helmut Sattmann. Most of the material originated from Sri Lanka (as Ceylon), Mexico, Rhodes (Greece) and Oman. The specimens in the collection were formerly revised by Quintero in 1980 and Weygoldt in 1996 and 1998. Today, the whip spider collection holds a total of 167 specimens, including 27 species in 10 genera and 4 families (Tab. 1). It includes types of 4 species. Supplementary information about these species will be given below.

Type specimens

Charinidae Quintero, 1986

Charinus ioanniticus (Kritscher, 1959) (syntypes)

= *Lindosiella ioannitica* Kritscher, 1959 (syn. by Weygoldt 1972)

Tab. 1: Species list of the Amblypygi collection at the NHMW. Nomenclature follows Harvey (2003, 2013).

Taxa	Inventory Number NHMW
Charontidae (1)	
Charon grayi (Gervais, 1842)	1426, 21841
Phrynichidae (14)	
Euphrynichus amanica (Werner, 1916)	9289
Euphrynichus bacillifer (Gerstaecker, 1873)	1428, 1429, 9279, 9280, 18731
Trichodamon princeps Mello-Leitão, 1935	21842
Phrynichus ceylonicus (C.L.Koch, 1843)	1431-1434, 1436, 1437, 1442, 11198, 15414, 21843
Phrynichus deflersi Simon, 1887	18221, 18222
Phrynichus exophthalmus Whittick, 1940	1430, 9290
Phrynichus jayakari Pocock, 1894	20930
Phrynichus pusillus Pocock, 1894	15415
Phrynichus scaber (Gervais, 1844)	1435
Damon annulatipes (Wood, 1869)	18241-18248
Damon brachialis Weygoldt, 1999	1440
Damon diadema (Simon, 1876)	9282, 9291, 19535
Damon medius (Herbst, 1797)	1438, 1441, 9281
Damon variegatus (Perty, 1834)	1439
Phrynidae (10)	
Acanthophrynus coronatus (Butler, 1873)	1444, 1450
Heterophrynus longicornis (Butler, 1873)	1443
Phrynus asperatipes Wood, 1863	1851
Phrynus gervaisii (Pocock, 1894)	9285, 9286, 21844, 21845
Phrynus parvulus (Pocock, 1902)	1448, 9287, 21846
Phrynus tessellatus (Pocock, 1894)	1449
Phrynus whitei Gervais, 1842	1452, 9283, 9284
Paraphrynus laevifrons (Pocock, 1894)	1453, 9288, 21847-21849
Paraphrynus mexicanus (Bilimek, 1867)	1446, 1447
Paraphrynus pococki Mullinex, 1975	1445
Charinidae (2)	
Charinus australianus cavernicolus Weygoldt, 2006	21850
Charinus ioanniticus (Kritscher, 1959)	1427, 19137-19140, 21167

This species was described by Kritscher 1959 as *Lindosiella ioannitica*, not only as a new species, but also within a new genus.

Location: GREECE, Island of Rhodes, City of Lindos. Found in crevices at the base and fundament of the so-called Johanniterburg, on 15th and 16th April 1959, leg. & det. Erich Kritscher

Inventory Number: NHMW 1427, 1♂ (as mentioned in the original description), 3♀♀ and 4 ♀♀ juveniles (=ST)

Remarks: In the original description, 8 specimens were mentioned, but there are in fact 9, including one prepared and positioned in the exhibition in the collection. The one in the exhibition is labelled as "Cotypus". This specimen can't be examined without being destroyed. In any case, it should be mentioned that Weygoldt (2005) recorded only 7 females (he examined the specimens in the collection, but obviously not the one from the exhibition and another one). As no holotype was designated in the original description, all specimens have to be considered as syntypes.

Charinus ioanniticus (Fig. 3) is distributed around parts of the eastern border of the Mediterranean (see below). The only European populations are located on the Greek islands of Rhodes and Kos (Kritscher 1959, Weygoldt 2005). Interestingly, the population on Rhodes is an all-female population that reproduces parthenogenetically (Weygoldt 2007). Here they

live in subterranean passages of the ancient city of Rhodes (a cave-like lifestyle) (Weygoldt 2005). This form of reproduction is very rare in whip spiders. It is known only in *Charinus acosta* (Quintero, 1983) (de Armas 2000, 2005) from Cuba. *C. ioanniticus* has also been reported from Turkey (Kovařík & Vlasta 1996, Weygoldt 2005, Seyyar & Demir 2007), Israel (Rosin & Shulov 1960) and Egypt (El-Hennawy 2002), but these populations all reproduce sexually.

Phrynichidae Simon, 1892

Damon brachialis Weygoldt, 1999 (holotype)

This species was described by Weygoldt (1999) in his revision of the genus *Damon*.

Location: MOZAMBIQUE. Surroundings of Boroma, "Afrika: Zambese", from the late 19th century, leg. P. Menyhardt, don. Dr. Karl Brancsik, det. Peter Weygoldt

Inventory number: NHMW 1440, 1♂ (= HT)

Remarks: This specimen was initially determined (most likely by Kraepelin) as *Damon variegatus* (Perty, 1834) (see Fig. 2).

Phrynidae Blanchard, 1852

Phrynus parvulus (Pocock, 1902) (lectotype)

= *Tarantula marginemaculata yucatanensis* Werner, 1902 (syn. by Quintero 1981)

This specimen was revised and synonymised by Quintero (1981) in his overview of the amblypygid genus *Phrynus* in the Americas.

Location: BELIZE. Jukatan, 1902, leg. Schmarda & Werner

Inventory number: NHMW 1448, 1♂ (LT)

Remarks: Quintero (1981) mentions two male holotypes, one of *Phrynus parvulus* (Pocock 1902), with type locality in Tikal, Guatemala (specimen examined from BMNH), and this particular specimen from the NHMW, with type locality in Belize.

We consider this specimen as lectotype by inference of holotype by Quintero (1981), according to ICZN Art. 74.6.

Paraphrynus mexicanus (Bilimek, 1867) (syntypes)

= *Phrynus mexicanus* Bilimek, 1867 (transferred after Mullinex 1975)

= *Phrynus cacahuamilpensis* Herrera, 1892 (syn. by Garcia Acosta 1977)

These specimens were described by Bilimek (1867) as *Phrynus mexicanus*.

Location: In the cave Cacahuamilpa in Mexico sitting on rocks, 14.1.1866, leg. Bilimek, det. Kraepelin.

Inventory number: NHMW 1446, 2mm (ST)

Remarks: Another juvenile specimen was found several days later at the same locality (NHMW 1447). In the original description, however, only two adult males are mentioned.

Checklist of the collection

The complete species list of the Amblypygi collection at the NHMW is summarized in Tab. 1.

Conclusions

The whip spider collection of the NHMW – with 167 specimens from 27 species – is considered to be a small one. Nonetheless, approx. 15% of the valid species of the world are deposited in the museum, and the collection has types of 4 species.

Note that the whip spider *Charinus ioanniticus* made it – as "object No. 59", titled "European Premiere" – into the book Top 100 of the NHMW (Ott et al. 2012). It states: "As until the middle of the 20th century there was no indication that this group of spiders existed at all in Europe. When arachnologist Erich Kritscher discovered this sample of a new species hiding in a crack in the wall at the Castle of the Knights of St. John in Lindos in 1959, it was truly sensational news". Interesting is also the comment on one (juvenile) specimen of *Charinus ioanniticus* (NHMW 1939) which was found dead in the spider net of *Pholcus* sp. ("von *Pholcus* gefesselt").

We would also like to point out one fact that can cause taxonomic problems, using *Trichodamon princeps* Mello-Leitão, 1935 (NHMW 21842) as an example: The right basitibia of leg IV is not divided, but it is a principal character of this genus that it should be divided. All other morphological characters (two small tubercles above the cleaning organ on pedipalp distitarsus, ventral tibial spine I not bifid, etc.) are correct. This 'non-divided' part is caused by a formerly broken leg which was regenerated over several molts. As this is not uncommon in Amblypygi, it is worth mentioning here.

Note that many of the species mentioned here are being captive bred and are available for scientific research – see Appendix. Contact the first author for further information.

Acknowledgments

We would like to thank Jürgen Gruber for important information about the history of the collection and Ambros Hänggi and an anonymous reviewer for their valuable remarks to improve the manuscript.

References

Armas LF de 2000 Parthenogenesis in Amblypygi (Arachnida). – Avicennia 12/13: 133-134

Armas LF de 2005 Notas sobre la biología reproductiva des amblypygido partenogenético *Charinus acosta* (Quintero, 1983) (Amblypygi: Charinidae). – Boletin de la Sociedad Entomológica Aragonesa 36: 271-273

Armas LF de 2012 Nueva especie de *Paraphrynus* Moreno, 1940 (Amblypygi: Phrynidae) de México y el suroeste de los EE.UU. de América. – Revista Ibérica de Aracnología 21: 27-32

Armas LF de & Teruel R 2010 Nueva escpecie de *Phrynus* Lamarck, 1801 (Amblypygi: Phrynidae) de Puerto Rico. – Boletín de la Sociedad Entomológica Aragonesa 47: 127-130

Bilimek D 1867 Fauna der Grotte Cacahuamilpa in Mexico. – Verhandlungen der Zoologisch-Botanischen Gesellschaft in Wien 17: 905-906

Blick T & Harvey MS 2011 Worldwide catalogues and species numbers of the arachnid orders (Arachnida). – Arachnologische Mitteilungen 41: 41-43 – doi: 10.5431/aramit4108

El-Hennawy HK 2002 The first record of Amblypygi from Egypt. – Journal of Arachnology 30: 452-453 – doi: 10.1636/0161-8202(2002)030[0452:TFROAF]2.0.CO;2

Garcia Acosta R 1977 Révision de los Amblipigidos de México (Arachnida: Amblypygi). Tesis, Instituto de Biología, Universidad Nacional Autonoma de Mexico, Mexico, D.F. 55 pp.

Giupponi APL & Miranda GS 2012 A new species of *Sarax* Simon, 1892 from the Philippines (Arachnida: Amblypygi: Charinidae). – Anais da Academia Brasileira de Ciências 84:165-173 – doi: 10.1590/S0001-37652012000100017

Harvey MS 2003 Catalogue of the smaller arachnid orders of the world: Amblypygi, Uropygi, Schizomida, Palpigradi, Ricinulei and Solifugae. CSIRO Publishing Huntingdon, Collingwood (Victoria, Australia). 385 pp.

Harvey MS 2007 The smaller arachnid orders: diversity, descriptions and distributions from Linnaeus to the present (1758 to 2007). In: Zhang Z-Q & Shear WA (Eds.) Linnaeus tercentenary: progress in invertebrate taxonomy. – Zootaxa 1668: 363-380

Harvey MS 2013 Whip spiders of the World, version 1.0. Western Australian Museum, Perth. – Internet: http://museum.wa.gov.au/catalogues-beta/whip-spiders [accessed at 24 October 2013]

Harvey MS & West PLJ 1998 New species of *Charon* (Amblypygi: Charontidae) from Northern Australia and Christmas Island. – Journal of Arachnology 26: 273-284

Kovařík F & Vlasta D 1996 First report of Amblypygi (Charinidae: Charinus *ioanniticus*) from Turkey. – Klapalekiana 32: 57-58

Kraepelin K 1895 Revision der Tarantuliden Fabr. (= Phrynidae Latr.). – Abhandlungen des naturwissenschaftlichen Vereins Hamburg 13: 1-53

Kritscher E 1959 Ergebnisse der von Dr. O. Paget und Dr. E. Kritscher auf Rhodos durchgeführten zoologischen Exkursionen, II Pedipalpi (Amblypygi). – Annalen des Naturhistorischen Museums Wien 63: 453-457

Mullinex CL 1975 Revision of *Paraphrynus* Moreno (Amblypygida, Phrynidae) for North America and the Antilles. – Occasional Papers of the California Academy of Sciences 116: 1-80

Ott I, Schmid B, Köberl C & Golebiowski R 2012 NHM Top 100. English Edition. Edition Lammerhuber und Verlag des Naturhistorischen Museums, Baden & Wien. 231 pp.

Pesta O 1940 Eduard Reimoser: Nachruf. – Annalen des Naturhistorischen Museums in Wien 51: 4-7

Prendini L 2011 Order Amblypygi Thorell, 1883. In: Zhang Z-Q (Ed.) Animal biodiversity: an outline of higher-level classification and survey of taxonomic richness. – Zootaxa 3148: 154

Quintero D Jr 1981 The amblypygid genus *Phrynus* in the Americas (Amblypygi, Phrynidae). – Journal of Arachnology 9: 117-166

Rahmadi C, Harvey MS & Kojima J-I 2010 Whip spiders of the genus *Sarax* Simon 1892 (Amblypygi: Charinidae) from Borneo Island. – Zootaxa 2612: 1-21

Rahmadi C, Harvey MS & Kojima J-I 2011 The status of the whip spider subgenus *Neocharon* (Amblypygi: Charontidae) and the distribution of the genera *Charon* and *Stygophrynus*. – Journal of Arachnology 39: 223-229 – doi: 10.1636/CA10-77.1

Rosin R & Shulov A 1960 Representatives of the order Amblypygi (Arachnida) found in Israel. – Bulletin of the Research Council of Israel 9B: 167-168

Seiter M 2011 Die Welt der Geißelspinnen (Arachnida, Amblypygi). Teil I: Einführung, Systematik & Phylogenie. – Arachne 16 (2): 28-37

Seyyar O & Demir H 2007 A new locality for *Charinus ioanniticus* (Kritscher, 1959) (Amblypygi: Charnidae). – Serket 10: 109-111

Weygoldt P 1972 Charontidae (Amblypygi) aus Brasilien. Beschreibung von zwei neuen *Charinus*-Arten, mit Anmerkungen zur Entwicklung, Morphologie und Tiergeographie und mit einem Bestimmungsschlüssel für die Gattung *Charinus*. – Zoologische Jahrbücher, Abteilung für Systematik, Ökologie und Geographie der Tiere 99: 107-132

Weygoldt P 1999 Revision of the genus *Damon* C.L. Koch, 1850 (Chelicerata: Amblypygi: Phrynichidae). – Zoologica 150: 1-45

Weygoldt P 2000 Whip spiders: their biology, morphology and systematics. Apollo Books, Stenstrup. 164 pp.

Weygoldt P 2002 Sperm transfer and spermatophore morphology of the whip spiders *Sarax buxtoni*, *S. brachydactylus* (Charinidae), *Charon* cf. *grayi*, and *Stygophrynus brevispina* nov. spec. (Charontidae) (Chelicerata, Amblypygi). – Zoologischer Anzeiger 241: 131-148 – doi: 10.1078/S0044-5231(04)70069-8

Weygoldt P 2005 Biogeography, systematic position, and reproduction of *Charinus ioanniticus* (Kritscher 1959),

with the description of a new species from Pakistan (Chelicerata, Amblypygi, Charinidae). – Senckenbergiana biologica 85: 43-56
Weygoldt P 2007 Parthenogenesis and reproduction in *Charinus ioanniticus* (Kritscher, 1959) (Chelicerata, Amblypygi, Charinidae). – Bulletin of the British arachnological Society 14: 81-82

Appendix

Checklist of the personal collection of Michael Seiter (as of 21.09.2013)
* means that from this species, individuals from more than one locality are available

Charontidae (1)
Charon cf. *grayi* (Gervais, 1842)*

Phrynichidae (12)
Damon annulatipes (Wood, 1869)
Damon diadema (Simon, 1876)
Damon medius (Herbst, 1797)*
Damon tibialis (Simon, 1876)
Damon variegatus (Perty, 1834)
Euphrynichus amanica (Werner, 1916)
Euphrynichus bacillifer (Gerstaecker, 1873)
Phrynichus ceylonicus (C.L. Koch, 1843)
Phrynichus deflersi arabicus Simon, 1887
Phrynichus exophthalmus Whittick, 1940
Phrynichus jayakari Pocock, 1894
Phrynichus orientalis Weygoldt, 1998

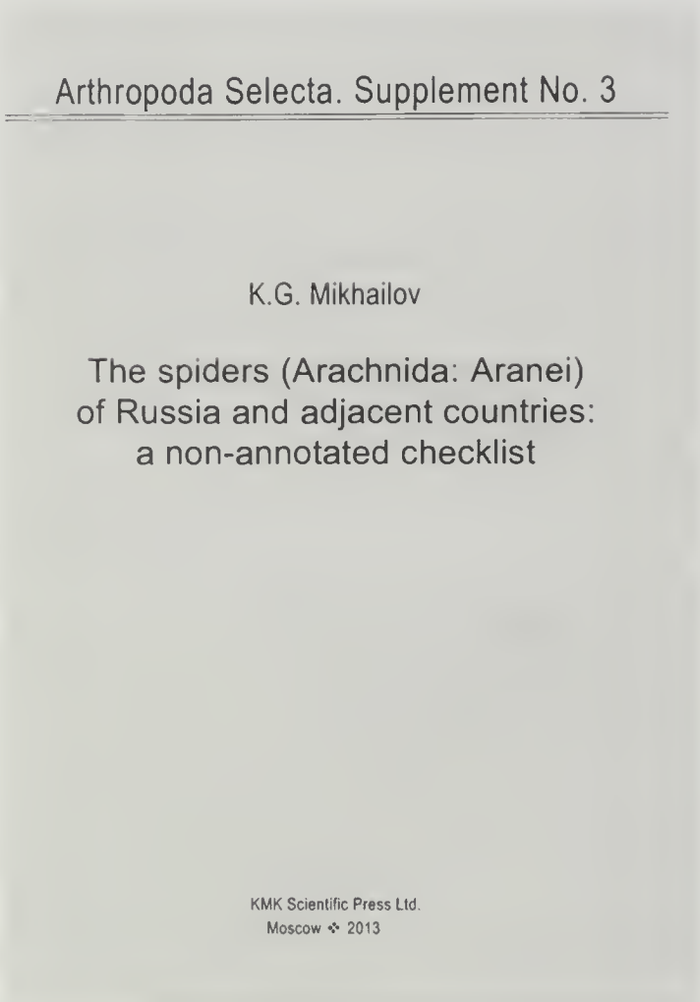
Phrynidae (30)
Acanthophrynus coronatus (Butler, 1873)
Heterophrynus batesii (Butler, 1873)
Heterophrynus cf. *elaphus* Pocock, 1903
Paraphrynus aztecus (Pocock, 1894)
Paraphrynus carolynae Armas, 2012
Paraphrynus cubensis (Quintero, 1983)*
Paraphrynus emaciatus Mullinex, 1975
Paraphrynus laevifrons (Pocock, 1894)
Paraphrynus mexicanus (Bilimek, 1867)
Paraphrynus raptator (Pocock, 1902)
Paraphrynus robustus (Franganillo, 1930)*
Paraphrynus sp. (from Mexico)
Paraphrynus viridiceps (Pocock, 1893)*
Phrynus asperatipes Wood, 1863
Phrynus barbadensis (Pocock, 1894)*
Phrynus damonidaensis Quintero, 1981*
Phrynus decorates Teruel & Armas, 2005*
Phrynus eucharis Armas & Pérez, 2002
Phrynus exsul Harvey, 2002
Phrynus garridoi Armas, 1994
Phrynus goesii Thorell, 1889*
Phrynus hispaniolae Armas & González, 2002*
Phrynus longipes (Pocock, 1894)*
Phrynus marginemaculatus (C.L. Koch, 1840)*
Phrynus noeli Armas & Pérez, 1994
Phrynus pulchripes (Pocock, 1894)
Phrynus sp. (from Dominican Republic)
Phrynus operculatus Pocock, 1902
Phrynus pinarensis Franganillo, 1930*
Phrynus whitei Gervais, 1842*

Charinidae (15)
Charinus acosta (Quintero, 1983)*
Charinus australianus cavernicolus Weygodt, 2006
Charinus centralis Armas & Àvila Calvo, 2000*
Charinus cubensis (Quintero, 1983)*
Charinus ioanniticus (Kritscher, 1959)
Charinus neocaledonicus Simon, 1895
Charinus tomasmicheli Armas, 2007
Charinus wanlessi (Quintero, 1983)
Sarax brachydactylus Simon, 1892
Sarax buxtoni (Gravely, 1915)
Sarax singaporae Gravely, 1911
Sarax sp. (from Indonesia, Bali)
Sarax sp. (from Indonesia, Lombok)
Sarax sp. (from Philippines)
Sarax yayukae Rahmadi, Harvey & Kojima, 2010

Buchbesprechung

Kirill G Mikhailov 2013 The spiders (Arachnida: Aranei) of Russia and adjacent countries: a non-annotated checklist

Moscow: KMK Scientific Press. Arthropoda Selecta. Supplement No. 3. 262 S. (überwiegend) Englisch. Softcover. 17,5 x 25,5 cm. ISBN 978-5-87317-933-6. Preis: 50 € (inkl. Versand innerhalb Europas). Bestellung: mikhailov2000@gmail.com



Auch wenn der Titel lediglich eine „non-annotated checklist" verheißt, handelt es sich tatsächlich um mehr. Es ist die Neuauflage bzw. die Fortschreibung des Kataloges von Mikhailov (1997) sowie von dessen Ergänzungen (Mikhailov 1998, 1998, 2000). Die Checklist (der Katalogteil) umfasst alle Arten, die in den heutigen Ländern der ehemaligen Sowjetunion bis einschließlich 2011 nachgewiesen wurden. Indirekt, d.h. nicht direkt pro Land ablesbar sondern bei jeder einzelnen Art, enthält die Arbeit damit Checklisten für Russland (2366 Arten), Estland (511), Lettland (419), Litauen (445), Weißrussland (431), Ukraine (1008), Moldawien (292), Georgien (520), Aserbaidschan (663), Armenien (136), Kasachstan (966), Usbekistan (331), Turkmenien (394), Kirgisien (479) und Tadschikistan (318) – insgesamt 3340 Arten aus 50 Familien. Alle Länder und Naturräume sind mit kyrillischen Buchstaben abgekürzt. Jeder Art sind ihre Vorkommen in den 15 Ländern und 24 Naturräumen („physiographical areas") zugeordnet, mit der Russischen Ebene als der artenreichsten Region (1362 Arten). Viele der Naturräume erstrecken sich über mehr ein als ein Land – eine Zuordnung der Artnachweise pro Land **und** Region ist ebenso wenig ablesbar wie zu einzelnen Quellen. Der Besprechung der 1997er Katalogs ist diesbezüglich nichts hinzuzufügen (Blick 1997).

Der Autor richtet sich, von wenigen angegebenen Ausnahmen abgesehen, nach der Version 14.0 des Platnick-Kataloges. Fragliche Nachweise („?") sind ebenso gekennzeichnet wie publizierte Fehlbestimmungen („??"). Ich fand keinen Hinweis ob bei den Artensummen die fraglichen Nachweise enthalten sind. Der Katalogteil umfasst den größten Teil des Werkes (p. 11–224), die Quellen (p. 225–231) enthalten lediglich die konkret zitierten Arbeiten. Die vollständigen Referenzen wurden gesondert publiziert (Mikhailov 2012). Der alphabetische Index der Gattungs- und Artnamen (p. 232–260) verhilft zu einem schnellen Finden der Spinnenarten. Kirill Mikhailov erhöht seine früheren Schätzungen auf 3700–3800 Arten für das gesamte Gebiet sowie auf 2500–2600 Arten für Russland und stellt gleichzeitig klar, dass er lediglich den momentanen Stand widerspiegeln kann („A faunistic study of the spiders of Russia and adjacent countries is yet far from complete".)

Ein wichtiges Nachschlagewerk.

Literaturverzeichnis

Blick T 1997 K.G. Mikhailov: Catalogue of the spiders of the territories of the former Sovjet Union (Arachnida, Aranei). – Arachnologische Mitteilungen 13: 56–57 – doi: 10.5431/aramit1309

Mikhailov KG 1997 Catalogue of the spiders of the territories of the former Soviet Union (Arachnida, Aranei). Zoological Museum, State University, Moscow. 416 pp

Mikhailov KG 1998 Catalogue of the spiders (Arachnida, Aranei) of the territories of the former Soviet Union. Addendum 1. KMK Scientific Press, Moscow. 48 pp.

Mikhailov KG 1999 Catalogue of the spiders (Arachnida, Aranei) of the territories of the former Soviet Union. Addendum 2. Zoological Museum, State University, Moscow. 40 pp.

Mikhailov KG 2000 Catalogue of the spiders (Arachnida, Aranei) of the territories of the former Soviet Union. Addendum 3. Zoological Museum, State University, Moscow. 33 pp.

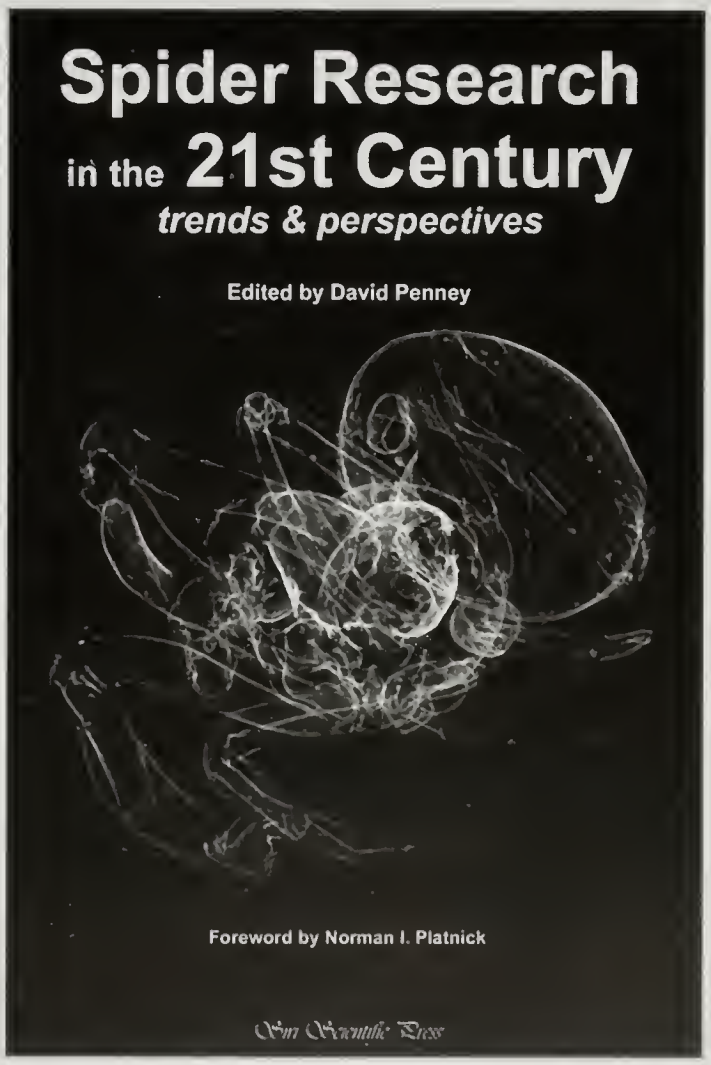
Mikhailov KG 2012 Bibliographia Araneologica Rossica 1770–2011. – Trudy Russkogo Entomologicheskogo obshchestva [Proceedings of the Russian Entomological Society] 83 (2): 1-229

Theo BLICK (theo.blick@senckenberg.de)

Buchbesprechung

David Penney (Ed) 2013 Spider research in the 21st century – trends and perspectives

Siri Scientific Press, Manchester. 320 pp. Hardback, in English. ISBN 978-0-9574530-1-2. Cost £ 83.00. Order: http://www.siriscientificpress.co.uk/Pages/default.aspx



The latest arachnological publication from Siri Scientific Press is a substantial compendium of spider-related topics covering many aspects of these fascinating animals' biology. As the title suggests, the overarching theme running throughout this work are the advances which have been made in recent years – particularly through the application of novel methods and/or technologies – as well as productive directions for future research. Following an extensive foreword by Norman Platnick, which summarises the book's main conclusions rather well, the volume itself is divided into nine self-contained and fully referenced chapters. All have been written by acknowledged experts in their fields and all provide an excellent account of the modern literature.

Rudy Jocqué, Mark Alderweireldt and Ansie Dippenaar-Schoeman examine biodiversity, with particular focus on Africa where they have carried out much research. They begin by defining biodiversity, and the challenges of estimating it in any given habitat. On the plus side, spiders are moderately large and (at least males) are fairly easy to identify, but a downside is that numerous collecting methods may be required to sample the whole fauna and some species occur only at low densities and are easily missed. Tropical regions obviously host more species, but Africa has some unique geological aspects such as a lack of dividing mountain ranges and a south–north tilt to the continent. Rudy and colleagues thus argue that African biodiversity is influenced by the complexity of the vegetation, the range of altitudinal variation and the presence of former refugia. They also explore phenomena such as how large numbers of morphologically similar species can co-exist. Using the 'template' concept – roughly equivalent to the characters which traditionally define a genus – they critically discuss how male genital characters in particular are used both functionally by spiders to identify conspecifics (e.g. Rudy's 'mate check' hypothesis), and practically by taxonomists to recognise biodiversity. Does

a slight enlargement of a palpal sclerite justify a new genus?

This leads nicely into the next chapter on systematics and phylogeny by Ingi Agnarsson, Jon Coddington and Matjaž Kuntner. They define this field as comprising (a) inventories, (b) taxonomic description and (c) phylogeny. The latter is the most 'modern' approach and strongly associated with theoretical advances (particularly cladistics), the incorporation of data from web-building and spinneret structure, and of course molecular data. The authors caution that molecular phylogenies have not lived up to their initial promise, but that this may be rectified by new sampling techniques (see below). Ingi and colleagues remind us that spiders are not hard to discover, but that the rate of species discovery continues apace; from which a (cautious) estimate of at least 120,000 species in total is proposed. For phylogeny, the authors review a wealth of recent studies and highlight discrepancies between results based on morphology, molecules and or combined 'total evidence' approaches. Ingi and colleagues call for more standardized approaches towards documenting characters. Taking Jon Coddington's 2005 consensus phylogeny as a starting point they, highlight those cades which continue to be well-supported and those, particularly deeply-rooted, clades which remain in flux. A novel molecular phylogeny is also offered – which controversially groups haplogynes with mygalomorphs – along with a request for more coordinated efforts between different labs in future.

Jordi Moya-Laraño and colleagues follow up with a contribution on evolutionary ecology. Certain spiders (e.g. *Nephila*) show extreme sexual size dimorphism: females weighing 100 times as much as males. A possibly explanation is a 'gravity hypothesis' – mature males need to be lighter to roam the vegetation in search of more sedentary females – although further avenues for research in this area are discussed. Next up is mimicry. For Müllerian mimicry, the authors note that relatively few spiders (e.g. *Gasteracantha*) display warning colours. More widespread are Batesian mimics, whereby ant mimicry is most prevalent among corinnids, gnaphosids and especially salticids. Trade-offs towards being an accurate or more generalist mimic are discussed. Colonial spiders (ca. 32 species) and truly social spiders (ca. 25 species) are considered in detail, weighing the advantages of cooperative hunting against the disadvantages of inbreeding; which may bias the sex ratio towards one male for eight females. Finally, the general ecological role of spiders can now be extrapolated from 'individual-based models' (IBMs) which explore how different parameters in the environment may influence spider ecology. Molecular tools are also becoming increasingly important for identifying exactly which prey items spiders have fed on based on DNA in the food remains.

Rosie Gillespie's theme is biogeography, where she argues that a major revolution in the 1970s was the realisation that land areas can split up (vicarience) and that this – and not just dispersion – can explain today's observed distribution patterns. Rosie offers examples of spiders with, for example, a 'Gondwanan' (i.e. southern hemisphere) distribution and shows how both the fossil record and knowledge of major geological events can contribute towards our understanding of which spiders live where today. From her own studies there is a particular focus on island biogeography; both the source of new colonists and the way in which they can then undergo adaptive radiation, such as in Hawaiian *Tetragnatha* species. Rosie suggests that in future biogeography may become a predictive science, able to model the effects of phenomena such as climate change or the arrival of invasive species.

Sara Goodacre takes on the complex subject of genetics and genomics; a field where technological advances are particularly important (and rapid). For example, the famous polymerase chain reaction (PCR) – which traditionally multiplied sufficient DNA for subsequent analysis – has now been largely superseded by the more efficient and cost-effective 'next generation sequencing' (NGS) which yields massive amounts of DNA without the PCR step. Sara also highlights the significance of RNA silencing, by which genes can effectively be 'switched off' in order to study their role during development. Molecular biology is now an integral part of much spider research, and Sara's chapter reviews how genetic data can help resolve phylogenetic relationships, act as genetic markers (microsatellites), and discusses the analysis of transcriptomes in social spiders, meaning those genes which are likely to be actively expressed. Also noteworthy is the possibility of creating artificial silk (see below). Sara concludes that in future it should be possible to recover increasingly large amounts of DNA, perhaps even from historical museum specimens, and that we may be able to barcode organisms from their whole genome; and

not just through the mitochondrial COI gene as has been done so far.

Klaus Birkhofer, Martin Entling and Yael Lubin remind us that spiders are key predators in many terrestrial ecosystems, and outline here their potential use in agroecology; particularly for biological control. They demonstrate that agricultural land use, such as pesticides, mowing, grazing, etc., generally has a negative impact on spider abundances. They reintroduce Jadwiga Luczak's term 'agrobiont' for those spiders which are regularly present in agricultural ecosystems. Thirty-one such species are recognised for Central Europe, characterised by – among other things – life cycles synchronized with agricultural usage; meaning that their vulnerable life stages occur at times when they are not affected by habitat disturbance. The spatial distribution and prey spectrum of argrobionts are further discussed and Klaus and his colleagues conclude that spiders can and do contribute to pest control as generalist predators; albeit with the caveat that spiders are also cannibalistic and/or attack other predators acting as potential pest control agents in argroecosystems. A few examples where spiders are thought to play a key role in biological control are critically reviewed.

Spider behaviour is the topic of Marie Herberstein and Eileen Hebets, who ask if (and why) spiders make good model organisms. They begin with a useful discussion of what a good model should be, before reviewing to what extent spiders have actually been utilised in the behavioural ecology literature. There has clearly been a tendency to focus on particular behaviours in particular taxa, such as signalling and courtship in the wolf spider *Schizocosa*, Friederich Barth's working group on neurobiology in the wandering spider *Cupiennius*, or sexual cannibalism and genital damage in the widow spiders (*Latrodectus*) and cross spiders (*Argiope*). Evidently spiders can and do learn and some may even have sacrificed their general body design to accommodate a proportionally large central nervous system. Their use of webs as 'extended phenotypes' (sensu Dawkins) also allows us to study how these animals are able to adapt their web-building to their immediate circumstances. Marie and Eileen conclude that observations of spider behaviour have moved on from being 'curiosities' to more rigorous studies placed in an evolutionary and/or ecological framework and that spiders now have great potential to contribute towards understanding wider theoretical questions in animal behaviour.

Spiders are largely defined by their unique ability to produce a diverse range of silks; a subject addressed by Jessica Garb. She begins with a comprehensive review of the probable origins, production mechanisms and mechanical properties of the various spider silks (up to seven in some species). A particular focus is the possibility of generating artificial silk; whereby the 'holy grail' is determining how spiders transform liquid silk proteins into solid fibres. Jessica also demonstrates how silk glands evolved up through the phylogenetic tree, e.g. major ampullate glands characterise araneomorph spiders, flagelliform glands define the araneoids, etc. The chapter continues with a molecular perspective on silk production and in particular spidroins: i.e. the structural proteins underlying silk fibres. Sequencing these long and repetitive proteins has proved a difficult technical challenge and previous attempts are comprehensively reviewed. New genetic techniques (see above) should make this easier in future and allow us to test hypotheses about silk evolution at a molecular level too. Jessica concludes with some possible applications in bioengineering – from medical ligaments to bulletproof vests – noting that the length of the spidroins has made them difficult to clone when transplanted into transgenic hosts: from bacteria, to silk worms, to goats!

Finally the editor, David Penney, rounds off the book with a chapter on palaeontology. Advances here include online databases with regular updates: a project which author of this review is involved in. Amber fossils in particular have benefited immensely from new imaging techniques, such as combining stacks of images in different focal planes or the use of computed tomography or synchrotron radiation to produce detailed, three-dimensional reconstructions. These allow fossils to be placed using largely the same morphological characters as living spiders, and enable palaeontological data to be integrated smoothly into studies on their living relatives. David highlights a number of key fossils (and fossil localities) discovered in recent years, and some of the ways in which the fossil data can be used to enhance topics from earlier chapters of this book; e.g. calibrating molecular phylogenies or reconstructing biogeographic scenarios. Future work should involve redescribing a number of problematic historical records and exploring the position (and validity?) of the extinct spider families. Particularly exciting is the possibility of recovering fossil DNA from copal; a very young fossil resin.

Taking the book as a whole, "Spider research in the 21st century" has been produced to a very high standard, with numerous colour images, all printed on good quality paper. The editing is tight and as far as I can tell, error-free. In fairness, this is not really a book for the beginner – Foelix's "Biology of spiders" remains preeminent here as a general overview – since the individual chapters can and do get rather technical in nature. Yet herein lies, I think, the strength of this work as a unique summary of the current state of play. Penney's volume is thus an excellent guide to the surprising diversity of research which is possible with spiders today; thanks largely to impressive theoretical and technological advances across a range of biological sciences. The one area which is perhaps not covered in so much detail is physiology, but for this Wolfgang Nentwig's 2013 revised edition of "Spider ecophysiology" would offer a complementary source of reference. In conclusion, for those of you actively working in arachnology (or their students), "Spider research in the 21st century" has to be very highly recommended. Yet even for readers whose interest in spiders is more casual, there is plenty to discover here out at the cutting-edge of our subject.

Jason A. DUNLOP, Museum für Naturkunde, Berlin, e-mail: jason.dunlop@mfn-berlin.de
[Reprint from the Newsletter of the British arachnological Society 127: 15-17, summer 2013]

Tagungsbericht

Bericht zum 19. Internationalen Kongress für Arachnologie, Kenting/Taiwan 2013
Report on the 19th International Congress of Arachnology, Kenting/Taiwan 2013

Organizing committee: Dr. I-Min Tso (Tunghai University), Kuo Yun Fang, Hsiao-Yu Tang, Dr. En-Cheng Yang, Dr. Sean J. Blamires, Dr. Pao-Shen Huang, Chen-Pan Liao, I-Ching Cheng, Ling-Fei Chen, Jo-Fan Wang, Ren-Chung Cheng, Yong-Chao Su, Po Peng, Hui-Yun Tseng.
Kongresswebseite mit zahlreichen Fotos: https://www.flickr.com/photos/98394366@N05/sets

Vom 23. bis 28. Juni 2013 fand der 19. Internationale Arachnologiekongress statt, zum ersten Mal in Asien, im subtropischen Süden Taiwans. Im luxuriösen Howard Beach Resort Hotelkomplex am Kenting Beach im Kenting Nationalpark am südlichsten Zipfel Taiwans trafen sich 248 ArachnologInnen aus 40 Ländern. 133 Vorträge und 69 Posterpräsentationen wurden gezeigt. Morgens wurden jeweils zwei 45-minütige Hauptvorträge vor dem versammelten Publikum gehalten, danach wurden Präsentationen parallel in 4 Vortragssälen gezeigt, wobei in jedem Saal ein anderes Themengebiet/Symposium behandelt wurde. Zwischen und nach den Vorträgen konnten die ArachnologInnen am Strand oder im riesigen Hotelpool bei 35°C das schöne Wetter geniessen und ihre Gedanken austauschen. Viele nutzten die Gelegenheit, um mit Keschern, Exhaustoren und Fanggläsern bewaffnet in der umgebenden Natur

Pekka T. Lehtinen und Shuqiang Li (Foto: Kongresswebseite)

auf Spinnentierjagd zu gehen. Zu erwähnen wäre der Nachtmarkt im Städtchen, wo unzählige kulinarische Delikatessen, wie z.B. Stinktofu (Nationalgericht, wird wirklich so genannt), fermentierte Eier, aber auch frittierte Oreo Kekse, angeboten wurden.

Am Sonntagabend, nachdem die meisten Gäste eingetroffen und registriert waren, gab es eine opulente Willkommensparty, nach der einzelne Gruppen von Gästen noch bis in die Nacht weiterfeierten. Der Montag begann mit einer Eröffnungszeremonie und einer Ansprache vom Organisator I-Min Tso. Der erste Vortrag wurde von Hirotsugu Ono gehalten, der die Geschichte der Spinnentaxonomie in Asien illustrierte. Shuqiang Li präsentierte die Fortschritte in der Erfor-

I-Min Tso (hinten, 3. von rechts) mit Studenten vom National Taiwan College of Performing Art (Foto: Kongresswebseite)

Kongressdinner, im Vordergrund von links: Vladimir Ovtcharenko, Boris Zakharov, Irina Marusik, Yuri Marusik, Robert Bosmans, Marij Decleer (Foto: Leila Gurtner)

schung der Spinnendiversität des Yunnan-Guizhou Plateaus in China. Des Weiteren gab es Präsentationen zu den Themengebieten Verhaltensökologie, Systematik und Biogeografie, Paläontologie und nicht-araneide Arachniden, Synökologie und Schädlingsbekämpfung.

Am Dienstag gab es Vorträge zum Thema sexuelle Selektion und ein Symposium über Arachnidendiversität, Urbanisierung und nachhaltige Entwicklung. Marie E. Herberstein hielt ein Plädoyer über die Vorteile von Spinnen als Modellorganismen und Daiqin Li präsentierte seine beeindruckenden Studien über UV Färbung von Salticiden. Am Dienstagabend fand dann die allseits beliebte Russian Party statt, bei welcher köstlicher Kaviar und geräucherter Fisch zusammen mit Vodka serviert wurden. Die Stimmung wurde mit Fortschreiten des Abends immer ausgelassener und es wurden viele Gespräche, auch informative, geführt, an die mancher sich noch lange erinnern wird. Am Mittwoch gab es organisierte Exkursionen. Wahlweise konnte man entweder in den nahe gelegenen Sheding Park, das National Museum of Marine Biology oder zum Nan-Jen See. Im wunderschönen Sheding Park gab es interessante Flora und Fauna zu bestaunen und vieles, was das Arachnologenherz höher schlagen lässt, auch weil die dortige Arachnidenfauna taxonomisch wenig aufgearbeitet ist. An den erodierten Felswänden aus ehemaligen Korallenbänken versteckten sich unter anderem verschiedene Hersiliiden, Scytodiden, Hexatheliden und grosse Sparassiden, welchen nicht nur von Peter Jäger nachgestellt wurde. Riesige Höhlenschrecken, Scutigeromorpha und Skolopender wurden auch beobachtet, sowie endemische Formosa-Makaken. Dank der guten Organisation gab es die Möglichkeit, eine Sammelgenehmigung zu erhalten und im Hotel war eigens ein Raum mit Binokularen eingerichtet worden, so dass man seine Funde gleich vor Ort bestimmen konnte.

Der Donnerstag startete mit einem Vortrag von Matjaž Kuntner, der eine neue Phylogenie der Nephilidae präsentierte, aufbauend u.a. auf biogeografischen, ökologischen, physiologischen, verhaltensökologischen und biochemischen Daten. Anschliessend zeigte Todd A. Blackledge eine Studie über die Evolution verschiedener biomechanischer Eigenschaften von Radnetzen. Im Verlauf des Tages wurden Vorträge gehalten zu den Themengebieten Verhaltensökologie, Systematik und Biogeografie, Weberknechte und Spinnseide. Zudem gab es ein *Nephila* Symposium, ein Symposium über Biodiversität, Faunistik und Naturschutz. Nach den vielen spannenden Vorträgen fand dann am Abend ein opulentes Kongressdinner statt. Bevor das grosse Essen jedoch begann, präsentierten uns Studenten vom National Taiwan College of Performing Art, eine sehr abwechslungsreiche und packende Show mit unglaublichen akrobatischen Einlagen.

Den letzten Tag des Kongresses eröffnete Tadashi Miyashita mit einem Vortrag über räumliche Verteilung und Dichte von netzbauenden Spinnen bezogen auf verschiedene Grössenskalen. Yael Lubin's Präsentation zum Gruppenleben von Spinnen war auch sehr spannend. Am Nachmittag fand man sich zum ISA Meeting zusammen, an welchem unter anderem verkündet wurde, dass der World Spider Catalog nun definitiv nach Bern kommt und dass der nächste ICA 2016 in Denver stattfinden wird. Während des Meetings wurden zudem die besten studentischen Vortrags- und Posterbeiträge bestimmt. In den Gebieten Verhalten und Ökologie wurden die folgenden Vorträge ausgezeichnet: 1. Platz: Marissia G. Cardillo, 2. Platz: Hao-Hai Chou, 3. Platz:

Ning Sun, 3. Platz: Roman Bucher. Für ihre Poster wurden ausgezeichnet: 1. Platz: Chung-Huey Wu, 2. Platz: Bor-Kai Hsiung, 3. Platz: Lenka Sentenská. In den Gebieten Systematik und Evolution wurden die folgenden Vorträge ausgezeichnet: 1. Platz: Elizabeth C. Lowe, 2. Platz: Jan A. Neethling, 3. Platz: Xin Xu, 3. Platz: Mercedes Burns. Für ihr Poster wurde ausgezeichnet: 1. Platz: Leila Gurtner. Nach der Verkündigung der Gewinner und einer kurzen Abschlussrede wurde dann der Kongress offiziell beendet und am Abend traf man sich noch auf ein Bier auf der Hotelterrasse. Im Anschluss an den Kongress konnte man sich noch für eine einwöchige Exkursion anmelden, um den östlichen Teil Taiwans zu erkunden und vielleicht der taxonomischen Unberührtheit der Fauna etwas entgegenzuwirken.

Wir möchten diese Gelegenheit nutzen um uns nochmals ganz herzlich bei den Organisatoren und den ganzen Teilnehmern dieses Kongresses zu bedanken. Ein spezieller Dank gilt auch den Helfern in den roten Kongress-T-Shirts, die zu jeder Uhrzeit am Information Desk anzutreffen waren. Im Allgemeinen ist zu sagen, dass die Taiwanesen unglaublich zuvorkommend und gastfreundlich waren und dass dieser Kongress nicht nur in Sachen Spinnentierforschung sehr bereichernd war, sondern auch dadurch, dass man einen Einblick in diese tolle Kultur erhalten durfte. Zum Schluss möchten wir noch darauf hinweisen, dass der 28. Europäische Arachnologiekongress, organisiert von Marco Isaia, Mauro Paschetta, Raquel Galindo, Alberto Chiarle und Rocco Mussat Sartor, im schönen Italien in Torino vom 24. bis 29. August 2014 stattfinden wird.

Miguel RICHARD & Leila GURTNER
m.r@students.unibe.ch,
leila.gurtner@students.unibe.ch

Tagungsbericht

Bericht zur AraGes-Tagung in Karlsruhe, 27.–29. September 2013
Report on the AraGes-Conference in Karlsruhe, 27.–29. September 2013

Am 27.9.2013 fanden sich Arachnologinnen und Arachnologen aus halb Europa im Naturkundemuseum Karlsruhe zu einer Tagung der Arachnologischen Gesellschaft ein. Sie begann Freitag nachmittags mit einem freundlichen Empfang durch die Familie und das Team Höfer im Museum. Abends wurden die teilweise müden Reisenden und einige externe Interessierte mit dem Schlagwort „Spidersex" wachgerüttelt. Gabriele Uhl leitete diese Tagung mit einem öffentlichen Vortrag über das Liebesleben der Spinnen ein. Sehr spannend präsentierte sie anhand von unvergesslichen Bildern und Filmen das Paarungsverhalten von Zwergspinnen. Im Pavillion des Museums gab es im Anschluss eine Erfrischung in Form von Säften und Wein, die von allen gerne in Anspruch genommen wurde. Peter Jäger nutzte gleich die Gelegenheit der Zusammenkunft und präsentierte uns stolz seine riesige digitale Sammlung arachnologischer Papers, die sich alle Interessenten im Laufe der Tagung kopieren durften. Der Abend klang in einer gemütlichen Runde in einem Lokal aus, mit weiterführenden arachnologischen Diskussionen und privatem Informationsaustausch

Abendessen am Freitag, von links unten im Uhrzeigersinn: Lars Friman, Jörg Wunderlich, Christoph Muster (verdeckt), Christian Komposch, Peter Jäger, Bram Vanthournout, Gordana Grbic, Stefan Otto (Foto: J. Schwab)

sowie mit georgischem Schnaps, den Stefan Otto mitgebracht hatte.

Der zweite Tagungstag begann thematisch wie der Vorabend geendet hatte, mit Spidersex. Die Effektivität der Begattungspfropfe bei Zwergspinnen wurde von Katrin Kunz präsentiert. Danach gab uns

Während der Vortrages von Jörg Spelda (stehend), von links: Günther Langer, Hubert Höfer, Christoph Muster, Jörg Wunderlich (Foto: C. Komposch)

die die brasilianische Weberknechtforscherin Rachel Werneck einen Überblick über die Kopulationbiologie bei Laniatores. Wir reisten während der Vorträge gemeinsam durch Europa und begaben uns auch in die tropischen Regionen. Elena Grall entführte uns nach Laos, wo sie sich gemeinsam mit Peter Jäger den Höhlenspinnen (Nesticidae) gewidmet hat. Axel Schönhofer klärte uns über die Phylogenie und Biogeographie der Weberknechtgattung *Ischyropsalis* auf. Florian Raub nahm uns mit nach Brasilien, wo er die Spinnendiversität von Sekundärwäldern untersuchte. Ambros Hänggi führte uns zurück nach Europa in die Stadt Basel und stellte uns gewöhnliche und ungewöhnliche Spinnenfunde aus dem Stadtgebiet vor. Von Christoph Muster wurde uns die Entwicklung von Spinnengemeinschaften in künstlich angelegten Torfmooskulturen in Norddeutschland veranschaulicht. Beim Thema Moorspinnen bleibend referierte Christian Komposch über die Indikatorfunktion von Spinnen am Beispiel einer Erfolgskontrolle von Moorrevitalisierungen in Oberösterreich. Abschließend widmeten wir uns noch aktuellen Projekten zu Biodiversitäts-Datenbanken wie „GBIF-Deutschland Knoten Wirbellose II", „Barcoding Fauna Bavarica" sowie „German Barcoding of Life GBOL", deren Stand und Entwicklung von Jörg Spelda und Hubert Höfer präsentiert wurden. Das Rätsel um die Spinne des Jahres 2014 löste Christoph Hörweg, mit der Baldachinspinne *Linyphia triangularis*. Die nächste im Raum stehende Frage „Wer erhält den Konrad-Thaler-Gedächtnispreis 2013?" wurde mit dem Auftritt von Bram Vanthournout und seinem Vortrag „Sex ratio distortion in the male dimorphic dwarf spider *Oedothorax gibbosus*: mechanisms and the role of endosymbiont bacteria" beantwortet.

Am späten Nachmittag fand dann die Mitgliederversammlung der AraGes statt. Ganze zwei Stunden wurden über die Geschehnisse der letzten drei Jahre berichtet und diskutiert. Christoph Muster führte uns durch die Mitgliederversammlung. Zu Beginn legten wir eine Gedenkminute für die verstorbenen Mitglieder Norbert Huber, Günther Scholl und Joachim Haupt ein. Danach folgte der Bericht des Vorstandes und der Kassenwartbericht. Einige personelle Umstrukturierungen wurden verkündet: Oliver-David Finch übergab die Schriftleitung an Sascha Buchholz, Detlev Cordes gab die Verantwortlichkeit für Layout und Satz an Stefan Scharf ab. Holger Frick stand aus persönlichen Gründen nicht mehr für die Wiederwahl in den Vorstand zur Verfügung. Allen wurde für ihre Tatätigkeiten und ihr Engegement gedankt. Es wurde auch daran erinnert, den Konrad-Thaler-Gedächtnispreis verstärkt zu bewerben. Im Anschluss wurde das Ergebnis der Vorstandswahl verkündet: Hubert Höfer, Christoph Muster, Ambros Hänggi und Peter Michalik (Kassenwart) gewannen die Wahl. In weiterer Folge setzte uns Theo Blick über die Entwicklung der Arachnologischen Mitteilungen ins Bilde: Diskutiert wurde unter anderem darüber, ob auf die Druckversion der AraMit verzichtet werden soll und ob der Diversa-Teil ohne doi-Vergabe gehandhabt wird. Eine Abstimmung über die Einführung deutschsprachiger Abstracts wurde mit einer eindeutigen Mehrheit befürwortet. Alle Mitglieder wurden dazu aufgerufen zu einer erhöhten Verbreitung der Zeitschrift beizutragen, Artikel nicht nur einzureichen, sondern diese auch zu zitieren, sowie pdfs auch selbst online zu stellen. Christoph Hörweg berichtete dann über die Aktivitäten und Treffen der SARA der letzten drei Jahre, sowie über die in diesen Jahren gewählten Spinnen des Jahres. Interessenten, die das nächste SARA-Treffen ausrichten möchten, sollen

Karl Hermann Harms (im Vordergrund), dahinter Volker Hartmann und Julia Schwab (Foto: C. Komposch)

sich bei Christoph melden. Abschließend präsentierte uns Peter Michalik die neue, sehr ansprechende Homepage und den Austragungsort für die nächste AraGes-Tagung im Jahr 2016: Greifswald.

Nach getaner Arbeit folgte dann wieder das Vergnügen. Im Afrika-Saal des Museums waren bereits die Tische aufgebaut und das Buffet ließ nicht lange auf sich warten. Angerichtet wurde „Saumagen", etwas für Nicht-Deutsche völlig Unbekanntes. Aber wer wagt der nicht gewinnt, und es hat wirklich sehr gut geschmeckt. Die Meinungen darüber, aus was der Saumagen jetzt wirklich besteht, gingen an diesem Abend jedoch auseinander. Die Insektenausstellung nebenan weckte bei vielen das Interesse – kein Wunder, gab es doch so viele geheime Türchen und Laden zu öffnen, um deren Inhalt zu erkunden. Für uns Naturforscher genau das Richtige. Nach 23 Uhr verlagerte sich die Party dann vom Museum in ein nahe gelegenes Restaurant. Eine lustige internationale Runde aus österreichischen, deutschen und belgischen Arachnologinnen und Arachnologen hatte sich also dort eingefunden. Bei Bier, Wein und Kuchen wurden einige hitzige Themen diskutiert, denn Deutsch ist nicht immer gleich Deutsch und schon gar nicht Österreichisch.

Für den Sonntag hat der Tagungsorganisator Hubert Höfer eine Exkursion durchs Museum geplant: Insektensaal, die wissenschaftliche Sammlung oder ein Blick hinter die Kulissen des Vivariums standen zur Auswahl. Im Vivarium wurde ein Tier von uns allen sofort ins Herz geschlossen – der handzahme Oktopus Vincent.

Das war also das Ende einer wunderbaren Tagung in Karlsruhe und der Beginn neuer Freundschaften. Wir freuen uns auf die nächste AraGes-Tagung in Greifswald 2016!

Julia SCHWAB MSc, Ökoteam – Institut für Tierökologie und Naturraumplanung, Bergmanngasse 22, A-8010 Graz, julia.schwab@edu.uni-graz.at

Korrektur

Correction: First record of the genus *Megachernes* (Pseudoscorpiones: Chernetidae) from Iran

During the elaboration of the paper by Christophoryová et al. (2013) we overlooked the fact that this pseudoscorpion genus had already been mentioned from Iran in a conference contribution by Mirmoayedi et al. (2000). This contribution was not included in the world pseudoscorpion catalogue (Harvey 2013) and none of the authors were aware of its existence (not even Dr. Dashdamirov who confirmed the pseudoscorpion identification for Mirmoayedi et al.). The paper contains records of *Megachernes pavlovskyi* Redikorzev, 1949 from bat guano from two Iranian caves and it represents the first record of this genus for Iran (Mirmoayedi et al. 2000). Our paper thus provides data about other specimens of *M. pavlovskyi* from another Iranian cave and its first record from a porcupine nest (Christophoryová et al. 2013).

Data for the records mentioned in Mirmoayedi et al. (2000):

IRAN (A. Mirmoayedi in litt., co-ordinates and m a.s.l. validated resp. elicited by help of google maps and google earth):

- Kilasefid cave, 34°40'N 45°52'E, 500 m a.s.l., Dasht Zahab, Kermanshah province, 1♂, 1♀, 9 July 2000
- Karafto cave, 36°20'N 46°52'E, 2000 m a.s.l., Divandareh area, Kurdistan province, 1♂, 2♀♀ 23 July 2000

References

Christophoryová J, Dashdamirov S, Malek Hosseini MJ & Sadeghi S 2013 First record of the genus *Megachernes* (Pseudoscorpiones: Chernetidae) from an Iranian cave. – Arachnologische Mitteilungen 46: 9-16 – doi: 10.5431/aramit4603

Harvey MS 2013 Pseudoscorpions of the world, version 3.0. Western Australian Museum, Perth. – Internet: http://www.museum.wa.gov.au/catalogues/pseudoscorpions (21 November 2013)

Mirmoayedi A, Sharifi M & Hemmati Z 2000 *Megachernes pavlovsky* (Redikozev 1949) [sic] species of pseudoscorpion, first record from Iran. Ninth Iranian Biology Conference, 15–17 August 2000, University of Tehran. p. 108

Jana CHRISTOPHORYOVÁ
christophoryova@gmail.com

Tagungseinladung

28th European Congress of Arachnology

The 28th European Congress of Arachnology (ECA 2014) will take place in Torino, in the north-west of Italy, from the 24th to 29th of August 2014. The Congress will be held in the Department of Life Science and Systems Biology of the University of Torino (main venue) and at the Regional Museum of Natural Science (supporting venue). Torino is a major business and cultural centre in Northern Italy, easy to reach from all of the main European cities. Torino has a rich culture and history and is known for its historical cafés, art galleries, fine restaurants, churches and palaces, nice squares and urban parks, libraries, museums and shopping centres.

Three mid-congress excursions will be organized (Alpi Marittime Natural Park, Langhe Region and Venaria Royal Residence and La Mandria Natural Park). Congress participants will be allowed to collect spiders and other Arachnids in all three excursions. Additionally, a post-congress excursion to the Bossea cave will be organized should there be enough participants.

A preliminary version of the Congress Program and Deadlines are available online.

After more than 20 years, we are pleased to welcome back the European Congress of Arachnology in Italy!

For any information please contact us at info@eca2014.it or check our website at www.eca2014.it

Arachnologische
Mitteilungen

Volume 46 Karlsruhe, November 2013

Inhalt/Contents

Dieter Martin: Aberrante Epigynenbildungen bei der Wolfspinne *Pardosa palustris* (Araneae, Lycosidae) . . . . . .
Aberrant epigyne shapes in the wolf spider *Pardosa palustris* (Araneae, Lycosidae). 1-5

Mario Freudenschuss, Tobias Bauer & Arnold Sciberras: *Menemerus fagei* new to Malta and Europe (Araneae: Salticidae) 6-8

Jana Christophoryová, Selvin Dashdamirov, Mohammad Javad Malek Hosseini & Saber Sadeghi: First record of the genus *Megachernes* (Pseudoscorpiones: Chernetidae) from an Iranian cave 9-16

Blerina Vrenozi & Peter Jäger: Spiders (Araneae) from Albania and Kosovo in the collection of Carl Friedrich Roewer. 17-26

Hay Wijnhoven: Sensory structures and sexual dimorphism in the harvestman *Dicranopalpus ramosus* (Arachnida: Opiliones) . . . . . .
Sinnesorgane und Sexualdimorphismus der Weberknechtart *Dicranopalpus ramosus* (Arachnida: Opiliones). 27-46

Michael Seiter & Christoph Hörweg: The whip spider collection (Arachnida, Amblypygi) held in the Natural History Museum Vienna, Austria . . . . . .
Die Geißelspinnensammlung (Arachnida, Amblypygi) des Naturhistorischen Museums Wien, Österreich. 47-53

Diversa: Buchbesprechungen, Tagungsberichte, Korrektur, Tagungseinladung . . . . . i-x

ISSN 1018 - 4171 www.AraGes.de